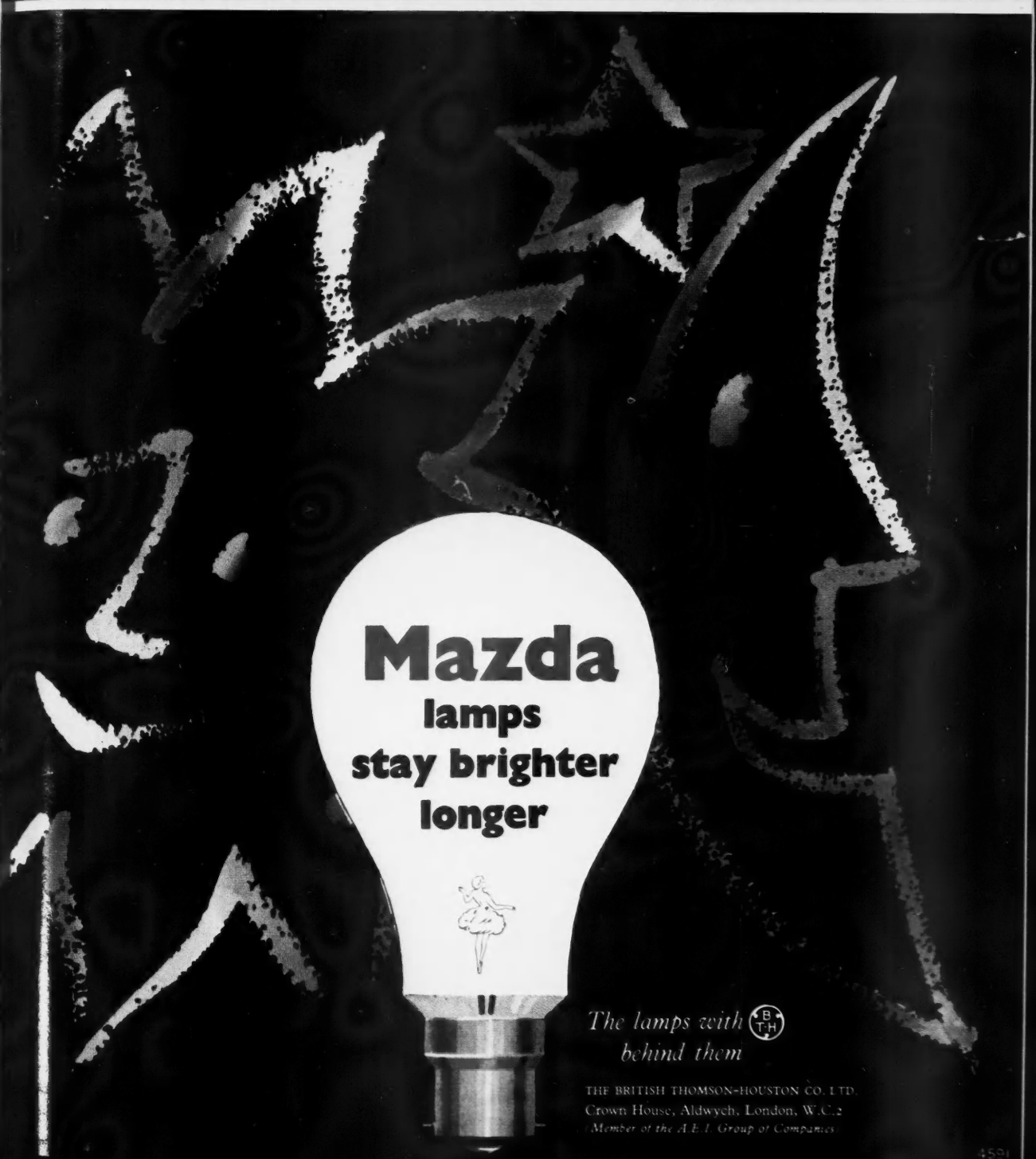
ELECTRICAL REVIEW



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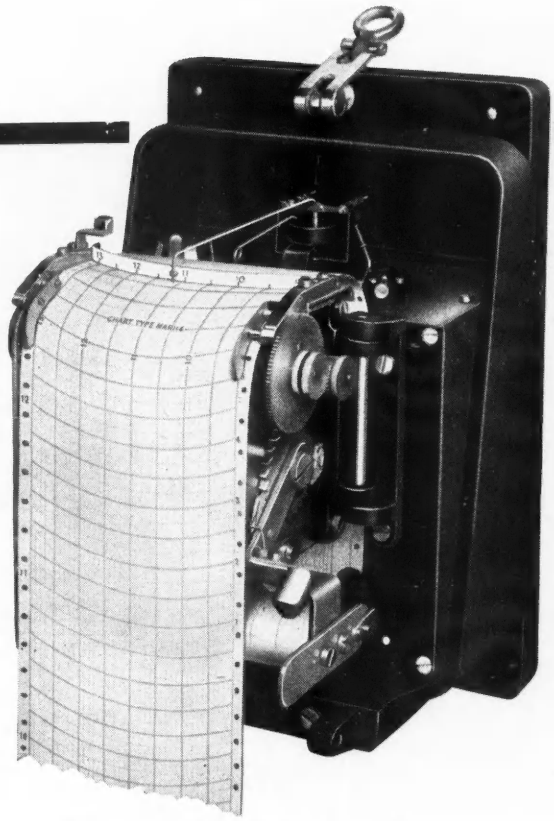

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ELECTRICAL REVIEW

13 January 1956 Vol. 158 No. 2 Established 1872

Keeping Up With Demand

THE usual annual statement of generating plant increases, this time for 1955, which was briefly summarized in our last issue and is dealt with in greater detail in this issue, was last week issued by the Central Electricity Authority. We do not think that a reasonable assessment of the trend of development can be made on a year-to-year basis, and in any case this is not the occasion for making such an assessment because sufficient information is not available; but this is no reason why some maybe useful observations and comparisons should not be made.

We see no special significance in the fact that the additional output capacity of new plant installed during 1955 was 1,721 MW, i.e., an increase of 290 MW over the figure for 1954, namely, 1,431 MW, except that it does line up with the anticipated growth in demand over the years and it certainly was a record. The 1955 increase is 8·9 per cent of the total installed capacity of 19,190 MW on 31st December, 1954, whereas the 1,431 MW increase in 1954 represented an increase of 8·0 per cent over 31st December, 1953, assuming that none of the already existing plant was put out of commission permanently during the periods in question. Of the 1,817 MW installed capacity of the new plant, 510 MW, or 28 per cent, represents initial plant in new power stations commissioned during 1955, while 1,306 MW (72 per cent) represents extensions to stations commissioned before 1955.

The new stations, namely, Portishead "B," Stella North, Wakefield "B," Marchwood, Meaford "B," Fleetwood and Goldington, represent rather a mixed bag from the operational viewpoint in that the first five will ultimately have six, four, four, eight, and four 60 MW sets, respectively, while the last two will each ultimately have six 30 MW sets. With one exception, Portishead "B," which will have twice as many boilers as turbo-alternators, all the stations will have one boiler per generating set.

Flexibility of operation is reflected in the fact that practically all these new stations are to be fired by pulverized fuel, one notable exception being Marchwood which is one of the stations lining up with the Government's coal conservation policy by the adoption of oil firing. The first four stations represent the advanced steam conditions of, say, the last two decades with pressures and temperatures both in the 900 range while Meaford "B" represents a considerable advance on these with 1,550 lb/sq in and 1,060 deg F; Fleetwood and Goldington both have the lower conditions common before the war of 600 lb/sq in and 850 deg F.

ECONOMIC AUXILIARY PLANT

Continuous technical developments in the generation of electricity and pronounced differences in local conditions are directly reflected in the choice of power station auxiliaries to suit individual circumstances. Economic assessment includes the valuation of the financial loss due to the taking out of service of a main generating unit, as a result of a defect in a perhaps minor auxiliary, against the cost of providing stand-by, possibly a form of over-insurance. Simplicity in operation and ease of maintenance have also to be considered. A difficulty is that decisions upon auxiliary plant layout and space allowance have to be reached at the planning stage before details of main plant items become available. Suggestions made by Messrs. G. F. Kennedy and F. J. Hutchinson, which are summarized on a later page, should enable close enough approximations to be reached as regards more advanced designs of power stations, subject to margins for contingencies, as determined by previous experience.

OUTPUT AND WAGES

Preliminary estimates of the results of the Census of Production for 1954 prepared by the Board of Trade cover about 70 per cent of all large establishments in manufacturing industry. The total figures for all branches indicate that while the value of output rose between 1951 and 1954 by 15 per cent (mainly on account of increased volume) employment rose by only 3 per cent. At the same time wages and salaries rose by 26 per cent. Advances in all these respects were much greater in the electrical branches. It will be seen from an extract from the tables in this issue that the output of the electrical engineering section rose by 34·7 per cent between 1951 and 1954; employment increased by about 17 per cent, and wages and salaries by over 49 per cent. In the electric wire and cable industry output was 21 per cent higher, while employment rose by 16 per cent and wages and salaries by 49 per cent. Corresponding figures for radio and telecommunications were: Output up by 34 per cent; employment by 18 per cent; and wages and salaries by 39 per cent.

FUEL CONSERVATION

In power station work a continuous effort is being made to increase thermal efficiency and now that operating temperatures up to and exceeding 1,000 deg F are the order of the day, the problem of heat leakage can assume serious proportions. This is well illustrated by a short description in the current issue of *Electrical Engineering* (the official journal of the American Institute of Electrical Engineers) of the two large stations at Clifty Creek, Indiana, and Kyger Creek, Ohio, which are being built by the Ohio Valley Electric Corporation to supply the Portsmouth uranium diffusion plant of the Atomic Energy Commission. These stations will together cost about £116 million and house eleven 215 MW turbo-alternator sets. Each set is cross-compound in design, operating from a single boiler at 2,000 lb/sq in and 1,050 deg F. Extensive use of thermal insulation, on pipes, breechings, boilers, and ducts to a large extent helps to make these two stations the most economical and efficient in the United States. A sum of nearly £1½ million has been spent on this insulation.

COMPLETE EDUCATION

So far the discussion of the need for a balance between scientific and cultural education has assumed a strict division between the two aspects and generally it has been contended that the scientists need culture. The other side of the shield was exhibited by Dr. J. Bronowski in an address to an education conference last week. He considered that it was the "arts" man who needed a broader education and that meant some acquaintance with science. There was a danger of the development of a world run by specialists for the ignorant, which would be a slave world. He was supported by Dr. A. W. Barton, headmaster of the City of London School, who said that the teaching of science in grammar schools was not a "regrettable necessity" but of equal importance to the humanities. This all seems to point to the undesirability of specialization at too early an age, that is before a student has a grasp of the complementary nature of the arts and sciences.

HYDRO-ELECTRIC AMENITIES

The account given in the I.E.E. paper on Highland water power developments, the discussion on which is reported in this issue, is impressive enough from the engineering angle. Even more to the point is the aid such developments are shown to bring to workers in agriculture, industry and the home in thinly populated areas. Former fears of damage to amenities have seemingly been proved groundless. As an example of the effect the other way, the prospect up Glen Affric is said by the Council for the Preservation of Rural Scotland to have been "improved by 100 per cent." The arrangements described for the protection of salmon appear to be quite satisfactory. The greatest contribution to amenity, however, as is pointed out in the paper, is the bringing of electricity to thousands of dwellers in the countryside and the remote glens and islands.

LESS COAL

Statistics of coal production during 1955 reinforce our argument that the development of nuclear power should be proceeded with at as fast a pace as men and materials allow. The output of saleable mined coal declined from 213·6 million tons in 1954 to 210·2 million tons last year. This decrease was only partly offset by a rise in the production of open-cast coal from 10·0 to 11·4 million tons. Only a small part of the decrease could be attributed to the smaller labour force, which declined by about half of one per cent. The reason was that fewer shifts were worked and "absenteeism" increased; more coal was lost through strikes than in 1954. Probably the most unsatisfactory aspect of the coal mining industry is the failure of production to rise proportionately to the degree of mechanization of the mines. This adds to the already high cost of coal instead of decreasing it as should be the case.

Single-Phase Induction Motors

Performance and design of split-phase machines

By "ROTOR"

THE torque created in an induction motor is due to the reaction between the current induced in the rotor conductors and the magnetic field. In a three-phase motor the currents in the distributed phases of the stator windings reach their peak values at different instants. Thus, the magnetic flux reaches its peak value at different instants in different parts of the motor. The combination of these fluxes produces a flux or fluxes of constant value, the axis, or axes, of which revolve round the stator core. The reaction between this flux and the induced rotor currents causes the rotor to be dragged round in the direction of the revolving flux. The torque is proportional to the product of stator flux, rotor current and the power factor of the rotor current. Thus the three-phase induction motor is inherently self starting.

Forces Produced by a Single-Phase Winding

However, a single-phase winding produces an alternating magnetic flux, not a revolving flux. Fig. 1 indicates the conditions in a single-phase motor at a particular instant when the rotor is at rest and the starting winding is not energized. At the given instant when the magnetic flux Φ_S and the stator currents have the direction shown, the motor will simply act as a transformer. Currents in the squirrel-cage conductors on the lower side of the rotor will flow towards the reader, as indicated by the dots in the conductor circles, whilst currents in the upper rotor conductors will flow away from the reader, as indicated by the crosses in the conductor circles. Maximum current will flow in conductors such as 6 and 18, which embrace the maximum flux, and minimum current will flow in conductors such as 24 and 12 which embrace only a small flux.

The direction of the force exerted on each rotor conductor is given by Fleming's left-hand rule and will be as shown, bearing in mind that the stator flux crosses the air gap radially by the shortest route. It will be noted that the torque due to conductors on two quarters of the rotor opposes that due to the conductors on the other two quarters. As a result the net torque is nil, and the motor will not be self starting, although it will hum and a considerable current will flow in the stator and rotor conductors.

Effect of Rotor Rotation

If, however, the rotor is rapidly turned by some external means, with the stator winding energized, e.m.f. will then be generated in the rotor conductors due to their cutting across the stator flux. Maximum e.m.f. will be generated in conductors such as 24 and 12 which will then be cutting the maximum flux. These generated e.m.f.s of rotation will produce currents in the conductors of the short-circuited squirrel-cage rotor, the induced currents being approximately a quarter of a cycle behind the e.m.f.s, since they produce a rotor magnetic flux at right angles to the stator flux, so that the generated currents act in a highly inductive circuit.

Whilst the induced rotor currents tend to produce flux in opposition to the stator flux, with resultant flux Φ_S along the magnetic axis of the stator windings, the generated rotor currents produce a flux Φ_R at right angles to Φ_S as indicated in Fig. 2 (a). The resultant flux then has the value and direction indicated by the vector Φ_T. Since the resistance of the rotor conductors is low compared with their reactance the flux Φ_R will lag behind the generated rotor e.m.f. by almost a quarter of a cycle in time as well as in space. The two fluxes Φ_S and Φ_R combine to produce the resultant flux Φ_T which revolves round the stator at synchronous speed in the direction in which the rotor is turned. The current induced in the rotor conductors then reacts with this revolving field to produce a torque in the direction of the revolving field. If the load is not excessive the motor will then accelerate to its running speed.

At low speeds the generated rotor currents will be small, as will also the flux Φ_R due to these currents. In consequence the resultant flux Φ_T will not then have a constant value as it passes round the motor, as shown in Fig. 2 (b). When the rotor accelerates its conductors cut the stator flux at an increasing rate, with consequent increase of

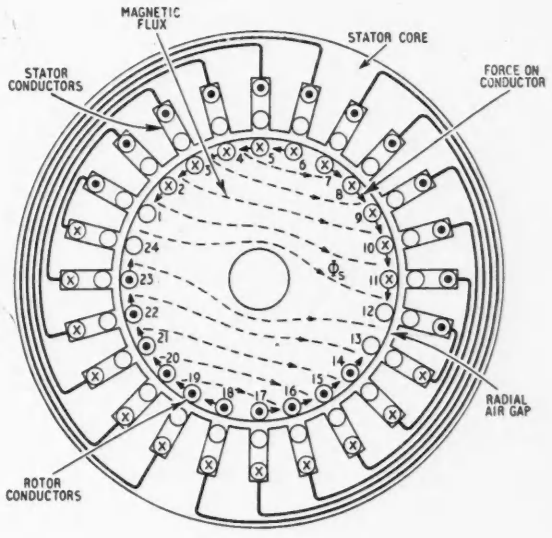


Fig. 1.—Currents in a single-phase motor at rest

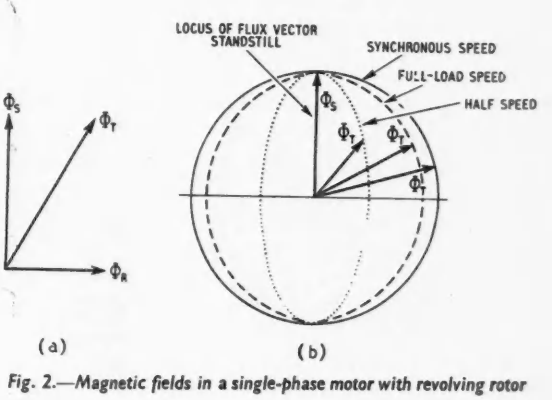


Fig. 2.—Magnetic fields in a single-phase motor with revolving rotor

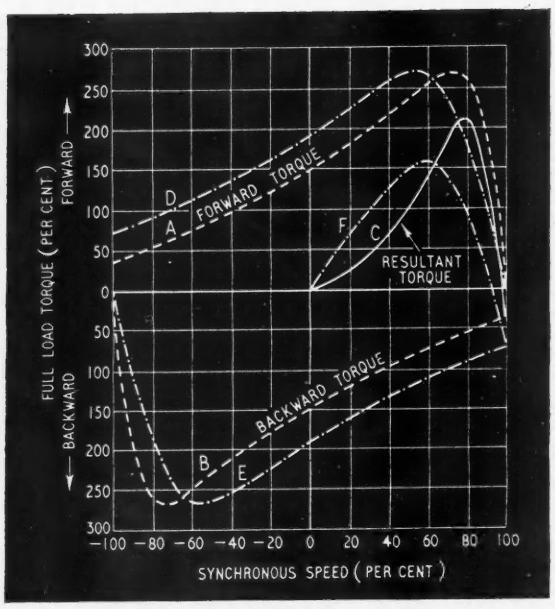


Fig. 3.—Component and resultant torques due to a single-phase stator winding

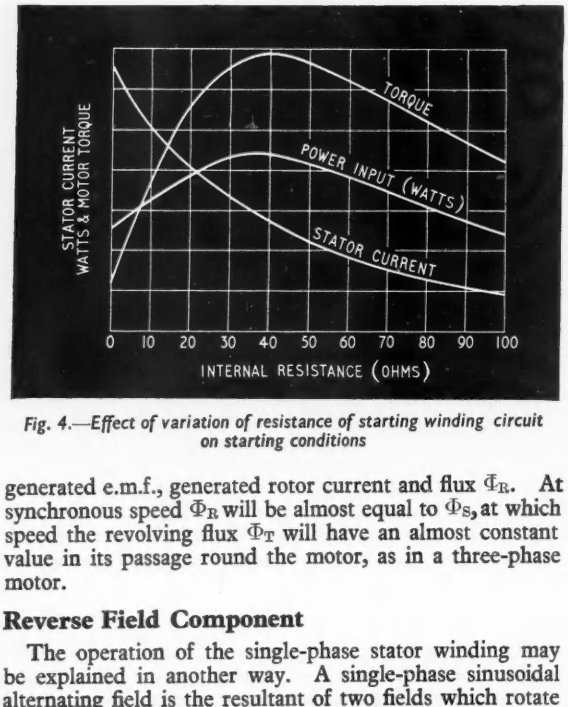


Fig. 4.—Effect of variation of resistance of starting winding circuit on starting conditions

generated e.m.f., generated rotor current and flux Φ_R. At synchronous speed Φ_R will be almost equal to Φ_S, at which speed the revolving flux Φ_T will have an almost constant value in its passage round the motor, as in a three-phase motor.

Reverse Field Component

The operation of the single-phase stator winding may be explained in another way. A single-phase sinusoidal alternating field is the resultant of two fields which rotate in opposite directions at synchronous speed, each field having half the strength of the single-phase alternating field. Once in each half cycle the two fields act in the same direction and the single-phase field then has maximum value; a quarter of a cycle later the two revolving components will act in opposite directions and the single-phase field will be zero. Each revolving component field may be considered to induce current in the rotor conductors and create torque as in a three-phase motor.

The torque due to one component field may be as represented by the curve A in Fig. 3. The other component field will revolve in the opposite direction, thus creating torque in the opposite direction as indicated by the curve B. Curve C shows the resultant torque acting on the rotor due to the component revolving fields of the single-phase field. Since the resultant torque is zero at zero speed the rotor will not be self starting. Curve C also shows that zero torque also occurs at slightly less than synchronous speed. Unlike the three-phase motor, therefore, the single-phase motor could not run at synchronous speed on no load even if it had no losses. In practice, however, the motor will run at almost synchronous speed on no load, once it has been started. The motor torque is subject to a pulsating component which alternates with twice the supply frequency.

Starting Windings

In order to make a single-phase induction motor self starting a special winding must be fitted on the stator to produce a component flux which reaches peak value at a different instant from that in the main stator windings, the axis of this auxiliary starting winding being midway between those of the main (running) windings. The fields combine to produce a resultant flux which, however, does not have a constant value during all instants of the a.c. cycle as in the case of a three-phase motor, because the peak value of the flux due to the auxiliary winding is less than that of the main single-phase winding, and also does not occur exactly a quarter of a cycle out of phase with that due to the main winding.

The phase displacement between the currents in the main (running) winding and those in the auxiliary (starting) windings may be produced in various ways. A resistor may be connected in series with one winding to reduce the angle of lag of the current in that winding behind the applied voltage. With a given running winding there is a value of resistance for the auxiliary winding circuit which gives maximum starting torque. This is the resistance value which causes the current in the auxiliary winding to lag behind the applied voltage by half the angle of lag of the current in the main winding. Fig. 4 shows results obtained with various values of external resistance connected in series with the auxiliary winding of a particular motor when the rotor is locked.

Another method of providing phase displacement is by fitting the starting coils in rather closed slots so that they produce an appreciable leakage flux, so that these starting windings have a high inductance and the current in these windings has a considerable lag, whilst the main windings are fitted in rather open slots to give the main windings a comparatively low inductance. The angle of lag of the current in a starting winding may be reduced by winding these coils of wire of comparatively high specific resistance or winding them so that the winding is partly non-inductive and yet has a high resistance, or using comparatively thin wire for the starting winding. In many split-phase motors the main (running) winding has more turns than the starting winding, the main winding being placed at the bottom of the slots with the starting winding, of lower inductance, at the top of the slots.

One type of starter for a single-phase induction motor employs contacts which connect the main and starting windings in parallel and feed them from the supply through a starting resistor in the starting position. The main stator winding only is energized, direct from the supply, in the running position of the starter. Another type of starter connects the starting winding direct across the supply at starting, whilst the main winding is energized through a starting resistor. The main stator winding again is the only one energized in the running position. In one starter a starting resistor is connected in parallel with the starting winding, this parallel circuit being fed from the supply

through the main winding during starting. With this starter the starting winding is cut out of circuit before the last section of the starting resistor is cut out.

Increase of rotor circuit resistance causes the forward revolving component of the single-phase field to produce its peak torque at a lower speed, as shown by curve D in Fig. 3. The peak torque due to the backward revolving component also occurs at a different speed, as indicated by curve E. The curve F refers to the resultant torque due to the revolving components of the single-phase field. It will be seen that increased rotor circuit resistance reduces the value of the peak torque and causes this to occur at a lower speed; it also reduces the speed of the motor on a given load to some extent, as well as reducing the starting current.

Hand-Operated Starter for Slip-Ring Motor

Fig. 5 shows the arrangement and connections of a starter for use with a single-phase slip-ring motor. The starter has an electromagnetic excess-current and no-current trip coil O, together with a phase-splitting device made up of a resistor R and a reactance X. In the first starting position the reactance X is connected in parallel with the starting winding S, this parallel circuit being connected across the supply through the resistor R, and the main stator winding R is connected direct across the supply. At the same time all the starting resistors R_1 R_2 and R_3 are connected in the rotor circuit. In the second position of the starter the motor is accelerated by cutting the section R_1 of the resistors out of the rotor circuit. In the third position the starting winding S and the phase splitter R and X are cut out of circuit, together with the second section R_2 of the rotor resistors. In the final (running) position of the starter the resistors R_3 are cut out, leaving the main stator winding M energized from the supply and the rotor windings short circuited.

Capacitor and Direct-Started Motors

The capacitor motor, of course, employs a capacitor in series with the starting winding to cause the current in this winding to lead that in the running winding by an appreciable angle. This method can be used to obtain as much as 350 per cent of full-load torque at starting. This article is mainly concerned with motors in which the revolving magnetic field for starting is produced by phase displacement between currents in the main and auxiliary stator windings. In the shaded-pole and the reluctance-start single-phase motors a phase displacement of magnetic fields in different parts of the motor is obtained by other means.

Most single-phase motors are of fractional horse-power size and are usually started by switching the stator windings direct on to the supply mains. A centrifugal switch is usually incorporated to switch out the starting winding when the motor has accelerated to about 75 per cent of synchronous speed. In some motors, however, a relay is provided which has a coil through which the motor current flows. When the motor is switched on, the high starting current causes this coil to close contacts which connect the starting winding in circuit. As the motor accelerates and the starting current falls this coil releases its contacts to cut out the starting winding.

The starting torque produced by the main and auxiliary stator windings largely depends on the resistance of the rotor, and on the value and phase displacement of the currents in the main and the auxiliary stator windings. Neither the main nor the auxiliary winding can produce starting torque alone, but the two combined windings can be designed to produce a reasonably high starting torque. Fig. 6 shows the speed-torque characteristics of two designs of motor. Fig. 6 (b) refers to a motor which has a fairly low efficiency and is designed mainly for use on drives which do not normally run for a large number of hours.

The magnetizing current of a polyphase induction motor flows only in the stator windings, thus the I^2R losses in the rotor of a polyphase machine are negligible on no load. However, the cross-field component Φ_R of the single-phase induction motor is produced by current in the rotor conductors, in consequence of which there are appreciable I^2R losses in the rotor of a single-phase motor even on no load. The maximum torque of the single-phase motor normally occurs at a fairly high percentage of synchronous speed, depending on the resistance of the rotor. Due to the backward component of the single-phase field the performance of the single-phase motor is inferior to that of a corresponding three-phase motor with a uniformly rotating field.

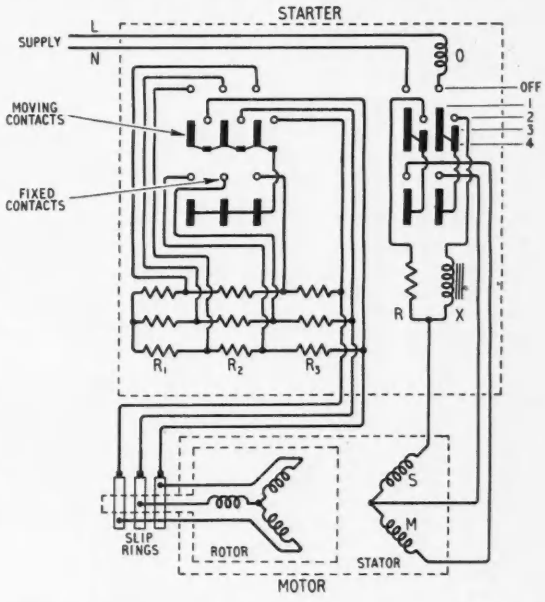
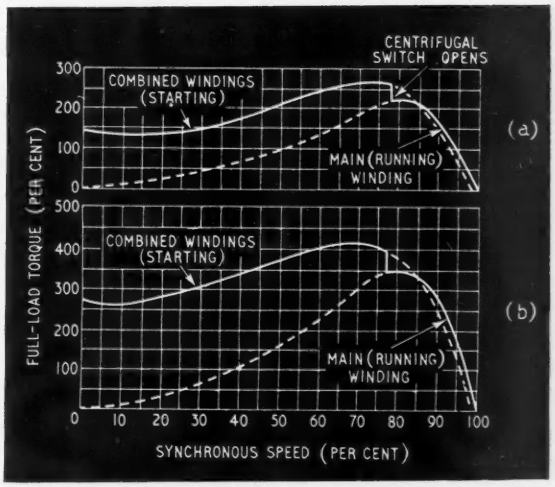


Fig. 5.—Connections of a hand-operated starter for a single-phase slip-ring motor

Fig. 6.—Speed-torque curves of two designs of split-phase start motor when switched direct-on-line



In addition the disposition of the windings does not permit the whole periphery of the stator to be utilized in establishing flux across the air gap to the same degree as in a three-phase motor. The no-load current of a single-phase motor is often a high percentage of the full-load current, whilst the starting current may be six or even eight times the full-load current.

Protection of Motors and Possible Troubles

Fig. 6 shows that as the motor accelerates from rest the torque falls somewhat. It is important that a motor should be chosen which has a minimum accelerating torque well above the resistance torque of the load, otherwise the motor may fail to accelerate to its correct speed and may continue to take a high starting current, with current continuing to flow through the starting windings. The current density in the starting windings may be about 40,000 A per square inch. Thus, it is most important that these windings should be de-energized as quickly as possible. Due to the high starting current it is often difficult to provide proper protection for the motor by means of line-connected excess-current trips, especially if the starting conditions are arduous so that the starting period is prolonged. However, reasonably good protection can usually be provided by means of a thermal device in the motor, which may also be heated by the passage of the motor current through a small element incorporated in the device, this apparatus being arranged to open contacts to switch off the motor if its temperature rises to a dangerous degree.

Failure to start may be due to low voltage, overload, rotor rubbing on the stator owing to worn bearings, dirt in the radial air gap, partly seized bearing, faulty lubrication, the centrifugal switch sticking open, faulty connections, open circuit, earth fault or short circuit in the starting or running winding circuit. Overheating when running may be due to overload, faulty ventilation, high ambient temperature, rotor rubbing on stator, dirt in the radial air gap, partly seized bearing, faulty lubrication, centrifugal switch sticking closed, too-frequent starting, earth fault or short circuit in the starting or running windings. The causes of reduced speed on load may be the same as those which result in a motor failing to start, the centrifugal switch sticking closed or a high resistance developing in the rotor.

NEW GENERATING PLANT

As we reported in last week's issue generating plant with an output capacity of 1,721 MW in forty stations (including seven new ones) was commissioned by the Central Electricity Authority in the twelve months ended 31st December last. The actual installed capacity was 1,838·5 kW including 21 MW of diesel-engined plant and two 30 MW sets in the Clyde's Mill station which vested in the South of Scotland Electricity Board on 1st April last. The appended table gives details of the new generating plant, boiler equipment and main high pressure pipework.

POWER PLANT COMMISSIONED BY THE C.E.A. IN 1955

Name of Station	Division	Turbo-Generator Plant		Boiler Plant		Main H.P. Pipework
		Installed Capacity MW	Makers	Capacity klb/hr	Makers	Makers
Steam Plant						
Acton Lane " B "	London	1×30	Richardsons Westgarth	1×240	Mitchell	Aiton
Battersea " B "	London	—	—	2×425	Babcock & Wilcox	Aiton
Blackburn	N. West, Merseyside & N. Wales	—	—	1×150	Simon Carves	Babcock & Wilcox
Brighton " B "	South Eastern	1×52·5	Richardsons Westgarth	2×320	Babcock & Wilcox	C. A. Parsons
Brimsdown " B " I.P.	Eastern	1×60	Richardsons Westgarth	2×340	J. Thompson	Stewarts & Lloyds
Brunswick Wharf	London	1×60	Metropolitan-Vickers	—	—	C. A. Parsons
Carmarthen Bay	South Wales	2×60	Metropolitan-Vickers	5×240	Babcock & Wilcox	Stewarts & Lloyds
Carrington	N. West, Merseyside & N. Wales	1×60	Metropolitan-Vickers	1×360	J. Brown	Stewarts & Lloyds
Clarence Dock	N. West, Merseyside & N. Wales	—	—	1×350	Babcock & Wilcox	Stewarts & Lloyds
Clyde's Mill	South West Scotland†	2×30	English Electric	4×180	Yarrow	Stewarts & Lloyds
Connahs Quay	N. West, Merseyside & N. Wales	2×30	C. A. Parsons	2×300	International Combustion	J. Thompson
Cowes H.P.	Southern	2×12	Brush	2×135	Daniel Adamson	Aiton
Doncaster " B "	Yorkshire	—	—	4×180	Mitchell	Aiton
Drakelow " A "	E. Midlands/Midlands	3×60	English Electric	3×515	International Combustion	Aiton
Fleetwood*	N. West, Merseyside & N. Wales	3×30	English Electric	3×300	Simon Carves & R. Westgarth	Stewarts & Lloyds
Goldington*	Eastern	2×30	British Thomson-Houston	2×300	Clarke Chapman	Stewarts & Lloyds
Hackney " B "	London	1×30	C. A. Parsons	1×300	Simon Carves	C. A. Parsons
Huddersfield	Yorkshire	1×30	General Electric Co.	1×180	Bennis	C. A. Parsons
Huncoat	N. West, Merseyside & N. Wales	1×30	General Electric Co.	—	—	C. A. Parsons
Ince	N. West, Merseyside & N. Wales	2×60	General Electric Co.	2×550	International Combustion	Babcock & Wilcox
Keadby	Yorkshire	1×60	C. A. Parsons	1×550	Stirling Boiler Co./B. & W.	C. A. Parsons
Littlebrook " C "	South Eastern	—	—	1×360	International Combustion	C. A. Parsons
Marchwood*	Southern	1×60	English Electric	1×550	J. Thompson	J. Thompson
Meaford " B "*	Midlands	1×60	British Thomson-Houston	1×515	Babcock & Wilcox	Babcock & Wilcox
Portishead " B "*	South Western	1×60	Metropolitan-Vickers	2×300	Mitchell	Stewarts & Lloyds
Skelton Grange " A "	Yorkshire	1×60	C. A. Parsons	1×550	International Combustion	Aiton
Staythorpe " A "	East Midlands	1×60	British Thomson-Houston	2×240	Babcock & Wilcox	Babcock & Wilcox
Stella North*	North Eastern	2×60	C. A. Parsons	2×550	Clarke Chapman	C. A. Parsons
Stella South	North Eastern	2×60	C. A. Parsons	2×550	Clarke Chapman	C. A. Parsons
Uskmouth " A "	South Wales	1×60	General Electric Co.	2×360	Babcock & Wilcox	Aiton
Wakefield " B "*	Yorkshire	1×60	English Electric	1×550	Foster Wheeler	Aiton
Woolwich	London	1×30	General Electric Co.	1×180	J. Thompson	C. A. Parsons
	Totals	39 and 1,817·5 MW		Totals	56 and 18,660 klb	
Diesel Plant		kW				
Alderley Edge	N. West, Merseyside & N. Wales	1×2,000	Mirrlees, Bickerton & Day			
Ashford " B "	South Eastern	3×2,000	Mirrlees, Bickerton & Day			
Basingstoke	Southern	1×1,050	Ruston & Hornsby			
Kendal	N. West, Merseyside & N. Wales	2×2,000	Mirrlees, Bickerton & Day			
Macclesfield	N. West, Merseyside & N. Wales	1×2,000	Mirrlees, Bickerton & Day			
Newbury	Southern	1×1,050	Ruston & Hornsby			
Southend	Eastern	1× 950	English Electric			
Walsall	Midlands	2×2,000	Mirrlees, Bickerton & Day			
	Totals	12 and 21,050 kW				

* Stations in which plant was commissioned for the first time in 1955. † This Division vested in the South of Scotland Electricity Board on 1st April, 1955.

NORWEGIAN RAILWAY ELECTRIFICATION

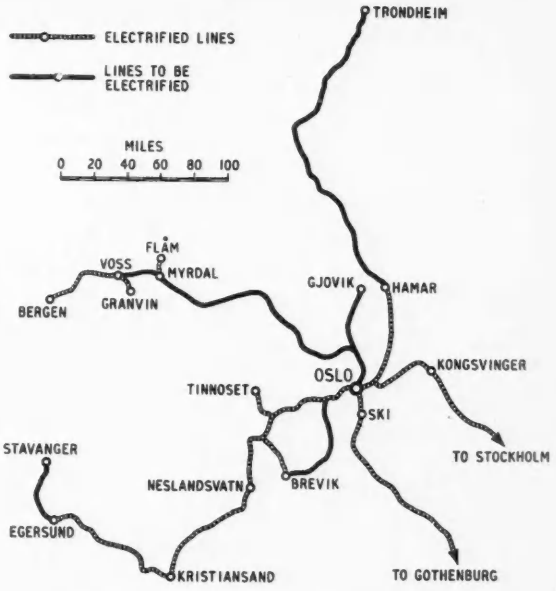
SURVEY OF PRESENT STATE OF DEVELOPMENT

From A Correspondent

NORWAY is among the countries where railway electrification with low-frequency single-phase current is firmly established. The system was not adopted without some controversy over the relative merits of direct and alternating current, but two committees reported in favour of a.c. in 1916 and 1922, and it is being retained in the present electrification programme of the Norwegian State Railways. This programme, originally aimed at increasing the electrified mileage in the country to 813, was extended in 1952 to cover a further 716 miles. On its completion about 56 per cent of the State Railways system will be electrified on the 15 kV, 16⅔ c/s system. At the present time 765 route miles of the State Railways are electrified out of a total of 2,722 route miles.

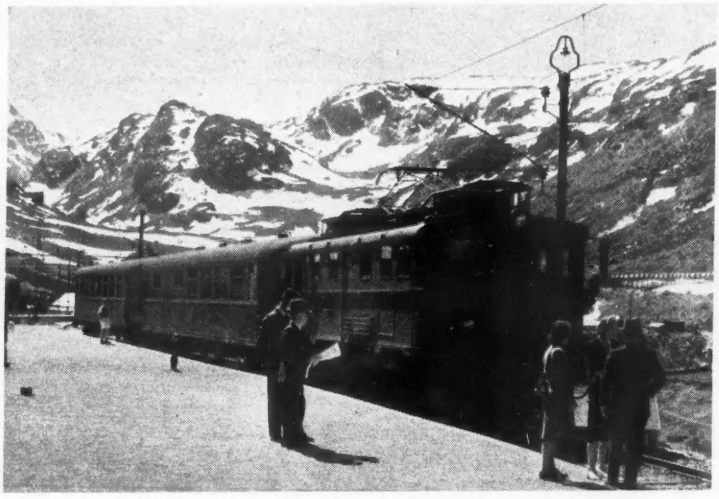
Electrification of the State Railways lines was considered as early as 1892 as a natural consequence of the abundant water power in the country. The first electrified line, however, was the privately-owned Thamshavn Railway, owned by a subsidiary of the Orkla Mining Company. It was built for transporting pyrites from Lokken to Thamshavn (15½ miles) but also operates passenger and ordinary goods services. The line was opened for electric traction in 1908 and equipped at first with two Westinghouse 160 h.p. locomotives, which are still in service. The 7 kV, 25 c/s single-phase supply is derived from two 1,250 kVA rotary convertor substations, either of which can meet the power requirements singly if necessary. Both substations are connected to a 15 kV line from the company's own hydro-electric station. Two 400 h.p. locomotives were acquired from A.S.E.A. in 1917. In 1950 two locomotives of 200 h.p. and one of 400 h.p. were supplied by N.E.B.B. (Norsk Elektrisk & Brown-Boveri).

Title picture shows :—Oslo East Station. The train on the left is hauled by a 3,600 h.p. electric locomotive from the Narvik line ; the train in the centre is an 820 h.p. multiple unit suburban set; and the train on the right is an express for the eastern line, hauled by a 900 h.p. electric locomotive from the Drammen line



Principal electrified routes of the Norwegian State Railways and lines scheduled for electrification

In 1912 it was decided to electrify the Oslo-Drammen line of the State Railways. The scheme was delayed by controversy over the system of electrification to be adopted, and the first section, as far as Brakeroya, was not converted until 1922. The line was opened for electric traction throughout in 1930. Various other lines, mostly radiating from Oslo, were electrified up to 1940, when the war precluded further work until after the liberation. Among the post-war work an important scheme has been the electrification from Oslo to the Swedish frontier station at Charlottenberg, as a result of which the Oslo-Stockholm expresses are now hauled throughout by electric traction. The only section of the original post-war programme which is still pending is Egersund to Stavanger. Of the new works authorized in the 1952 electrification programme the longest single stage will be that from Hamar to Trondheim, 264 miles, which will provide continuous electrification



Flam train at the side platform at Myrdal station

from Oslo to Trondheim, 346 miles. Electrification from Voss to Oslo is planned in two stages. These and the existing Bergen-Voss scheme will combine to give 314 miles of electrified main line crossing the country from east to west.

It has been estimated that the annual cost of electric power on the lines already electrified is about 30 million kroner less that that of the coal required to work the same traffic with steam locomotives. Originally, it was the policy for the railways to generate their own power and a station was therefore built at Ekeren with a capacity of 10,800 kVA from four hydro-alternators. Power is transmitted at 55 kV to four substations where it is transformed to 15 kV for the overhead contact system. Later, two 6,250 kVA single-phase sets were installed in the Nygard power station of the municipality of Narvik to supply the Ofoten Railway between Narvik and the Swedish frontier at Riksgransen, whence the Swedish State Railways line runs to the iron ore mines at Kiruna, in Lapland, and on to the Baltic coast at Lulea. The whole of this route, with its connection from Boden to Stockholm, is electrified. The importance of the short section in Norwegian territory derives from the fact that it gives access to a port—Narvik—which is open throughout the year, whereas Lulea is frozen during the winter. It is some 140 miles beyond the Arctic Circle and the most northerly electrified line in the world.

More generating plant was installed at Myrdal, on the Bergen-Oslo main line, to supply the electrified branch to Flam. Here the equipment consists of two sets, each consisting of a turbine, a 625 kVA single-phase generator and an 850 kVA three-phase generator. The Flam branch was opened in 1944 and electrified from the beginning. Between the junction at Myrdal and the shores of the Sognefjord at Flam there is a difference in level of 2,843ft in a distance of a little over 8 miles. The distance by rail is 12½ miles, for at one point the line describes a complicated spiral, largely in tunnel, in the course of which it twice passes beneath its upper section. Even so, it was impossible to avoid long gradients of 1 in 18 for a distance of 6 miles.

The present policy of the State Railways administration is not to build power stations but to install convertors for supplying a single-phase output at 16⅔ c/s from the industrial three-phase network. Fifteen rotary sets for this purpose have been ordered from Sweden and deliveries are due for completion this year. Provision has been made for the purchase as the programme proceeds of 67 locomotives, 44 motor coaches and seven express motor coaches, the equipment being built in Norway. It is estimated that electrification will proceed at the rate of about 62 miles per year, and that the work outstanding will be completed in 11 or 12 years. In some parts of the country very heavy civil engineering works are involved in preparing for electrification. The line to Bergen is a good example of this, having some 200 tunnels which require enlarging to take the overhead line. On the Bergen-Voss section, where this work has already been done, there are about 70 tunnels in a distance of 66 miles.

Recent calculations have shown that the running costs of steam locomotives in Norway are a little more than twice those for electric units. At the same time electric locomotives and motor coaches have been running about two and a half times the annual mileage of individual steam locomotives. There is therefore every incentive to electrification in the interests of economy, apart from possible increases of traffic attracted by improved services. The ultimate objective is the elimination of steam traction in Norway, diesel power being used on the 1,250 miles of line not scheduled for electrification. Diesel traction will replace steam on lines which will eventually be electrified as soon as diesel locomotives become available, and as the conversion programme proceeds the diesel units will be transferred to the non-electrified sections of the State Railways system.

Polythene Developments

IN an address to the Manchester Association of Engineers on 6th January, Mr. A. Renfrew (Imperial Chemical Industries) discussed the rapid growth in the use of polythene since the first ton was produced in 1938 as a substitute for guttapercha; the world output was now 150,000 tons a year and was expected to reach over 1·5 million tons in 1965. The first submarine cable insulated with polythene was made in 1939 and showed no signs of deterioration when examined recently. During the war 1,000 miles of defence cable were laid and proved essential to the efficient functioning of airborne radar. Its four outstanding features were: high dielectric strength; low loss factor even at centimetre wavelengths; moisture repulsion; and flexibility over a wide range of temperature. It was now recognized that polythene was not one plastic but a whole range of materials.

Creep was accentuated with increase in temperature. In relation to time it was rapid at first, but soon became very slow—the reverse of the action of lead. Impact strength when used for pipes was extremely high. With densities of 0·92 and 0·98, polythene melted sharply at 111 deg C and 130 deg C. Its power factor changed little with frequency or with temperature, but was adversely affected if allowed to oxidize. Permittivity at 20 deg C was 2·3 from 50 to 10^{10} c/s and dielectric strength at 50 c/s was 400 kV/cm.

The cable industry took 30 per cent of the polythene used in Britain, but developments for power cables had been disappointing owing to the low softening point and corona discharge in small voids between insulation and conductor.

Engineering in Europe

ABSTRACTS FROM FOREIGN TECHNICAL JOURNALS

THE intrinsic difference between flashovers of clean and dirt-coated insulators consists above all in the fact that these apparently similar phenomena actually constitute quite different types of discharges. The flashover of a clean and dry insulator surface always (unless it is a discharge through air) represents the same type of discharge, viz. a pure creepage discharge due to electrostatic charges accumulated on the surface. The flashover of wet and dirty insulator surfaces, however, may take at least three different forms, none of which is of a kind similar to a creepage discharge. These three main types are: the diffuse glow discharge, the luminous filament discharge, or glow arc with transverse movement; and the glow arc with running focal spot (longitudinal movement).

The first two of these types are also known as " drying " discharges, and all three are observed on initially continuous water films. The third type may be regarded as a spontaneous thermal breakdown of the film and may be artificially produced by altering the structure of the liquid film in a way producing striations or " ribs " on its surface. These different physical phenomena, and combinations of them, are produced by solid deposits on insulators, and the kind and distribution of the deposits are obviously capable of the widest variations, these being reflected by a corresponding variety of the forms of flashover. However, a comprehensive series of experiments carried out by the authors on shed-type and grooved insulators covered with films of kieselguhr (a particularly suitable hygroscopic material of low electrical conductivity) enabled most of the possible types of flashovers to be producd and investigated in the laboratory under conditions approaching fairly closely any possible conditions of actual service.—" Flashover of Extraneous Films on Insulators," H. v. Cron, *Siemens-Z.*, Vol. 29, No. 10, pp. 427-434, September, 1955, in German.

Current Transformers in Rectifier Circuits

In rectifier installations current transformers are connected to circuits in which the mean value of the current is zero, viz. the circuits of the primary windings of the rectifier transformers, of the secondary windings of the rectifier transformers in full-wave rectifier circuits, etc. When the rectifier works on an inductive load, the currents in these circuits have a trapezoidal wave form; in some cases the character of the secondary currents of the current transformers may then considerably differ from that of the primary currents. This distortion of the shape of the secondary currents is due to saturation phenomena in the core of the current transformer.

These conditions were investigated by testing the performance of several current transformers with cores consisting of permalloy-type materials and of electrical steel. The results indicated that permalloy-cored current transformers are unsuitable for measurements in 50 c/s rectifier circuits, but that the errors of current transformers with cores of electrical steel are comparatively small. It is also necessary to select the rating of current transformers for measurements on rectifiers in such a way that overloading of the current transformers is avoided. It is recommended that there should be included in the type-test programme of the c.t.s a test with d.c. supplied to the primary during which oscillograms of the secondary current are obtained. This will clearly show the suitability or otherwise of the current transformer for measurements in rectifier circuits.—" The Suitability of Current Transformers for Measurements in Rectifier Circuits," E. L. Ettinger and Yu. A. Shmain, *Elektrichestvo*, No. 9, pp. 71-73, 1955, in Russian.

380 kV Swedish Transmission

The fact that Sweden is the first country with a 380 kV transmission system in operation arises from the great distances between its hydraulic power resources and the industrial power-consuming centres. At the present stage the 380 kV system still runs partly (for over 500 km) parallel with six 220 kV lines and is interconnected with the general 220 kV grid. Some of the special problems arising in the operation of the system arise from this fact. Others refer to insulation and its co-ordination, the required impulse withstand voltage of the surge diverters, considering the solid earthing method chosen, and the withstand voltage of the line itself.

The last problem resolved itself, since atmospheric surges are very rare in the parts traversed by the lines. The synchronous stability of the transmission was considerably improved (30 per cent) by the use of grouped conductors (two per phase) and may be further increased by increasing the number to three conductors per phase. The charging current has a marked effect on the voltage constancy during low-load periods so that voltage control by high-speed regulators has to be supplemented by compensating reactors. Rapid reclosing, though not appreciably influencing the system stability, has been operated with advantage for reliability of the supply.

Single-pole rapid reclosing seems to offer possibilities for shortening unavoidable service interruptions in the case of multi-phase faults, at least up to certain limiting distances. The problem of intermediate stations found a natural solution because the largest supplying power station (Midskog, 1,000 MW) is situated roughly in the middle of the total distance covered by the line. The series capacitor installation has often been described and discussed. Questions of radio interference, earthing and experience with transformers and switchgear are only briefly touched upon.—" Problems of the Swedish 380 kV Three-Phase Transmission," I. Herlitz, *E.T.Z.(A)*, Vol. 76, pp. 585-590, 1st September, 1955, in German.

Insulation Performance

The conditions in an impregnated paper insulation simultaneously stressed by a.c. and d.c. were investigated by obtaining oscillograms of the loss current. This method has the advantage that the relation between the curve form of the loss current and the magnitude and curve form of the voltage applied is quite obvious. It is particularly marked in the case of capacitor sections after some years of service. If $E<2$ kV/mm, the current curve is sinusoidal, but for $E>2$ kV/mm the curve becomes distorted by the appearance of a peak corresponding to the steepest rate of rise of the voltage applied. It indicates that the oil ions in the oil-

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review*.

filled interstices between the paper layers cover the distance between the two layers in the direction of the lines of force within less than one half-period of the voltage wave. The ordinate, together with the abscissa of the ionic-current peak, indicates the ratio of oil ions in the layer to those accumulating at the separation oil-paper. It is possible to calculate the conductivity of the oil in the interstice from the results of the observations. The effect of the constant voltage applied depends on whether or not the field strength in the oil interstice changes its sign. In the second case the physical conditions are that the oil ions are pressed against the separation oil-cellulose and their mobility is greatly reduced. In the case of capacitors, and in the voltage range below 35 kV, this leads often to a considerable reduction of the losses and increased service life. The superposition of d.c. on alternating voltages hardly alters the ionization potential determined by the latter. The voltage rating of the insulation should be based on the a.c. operating voltage only, provided the amplitude of the d.c. component does not exceed the permissible value for d.c. capacitors of a similar type (usually 35-40 kV).—"Performance of Impregnated Paper Insulation in A.C. Operation in the Presence of a D.C. Component," G. S. Kuchinskii, *Elektrichestvo*, No. 10, pp. 45-49, 1955, in Russian.

Experimental Steelmaking and Rolling

DURING a visit to the Swinden Laboratories of the Research and Development Department of the United Steel Companies, Ltd., at Rotherham, we saw some of the recent additions which have been made to the engineering, metallurgical and research facilities. These include new electric steelmaking furnaces and an 11in three-high experimental hot rolling mill.

The furnace plant, which has been installed by the Electric Furnace Co., Ltd., embraces three high frequency electric steel melting furnaces capable of producing experimental ingots of 5 lb, 25 lb and 112 lb weight respectively. High frequency power is fed to the furnaces by a motor alternator set of Electric Construction Co., Ltd., manufacture with an output of 50 kW at 9,900 c/s single-phase; the 96 h.p. 3,000 r.p.m. driving motor operates from 415 V, three-phase, 50 c/s mains.

The rolling mill is situated in the same building, adjacent to the furnaces, and was supplied by B. Thornton, Ltd. It is driven by a Metropolitan-Vickers 100 h.p. a.c. motor through a David Brown four-speed gear box, "Radicon" worm reduction gear, and pinions. It is served by an electric direct resistance billet heater designed and constructed by the staff of the Research Department, and also by a 4ft square hearth gas-fired muffle furnace of "Thermic" design.

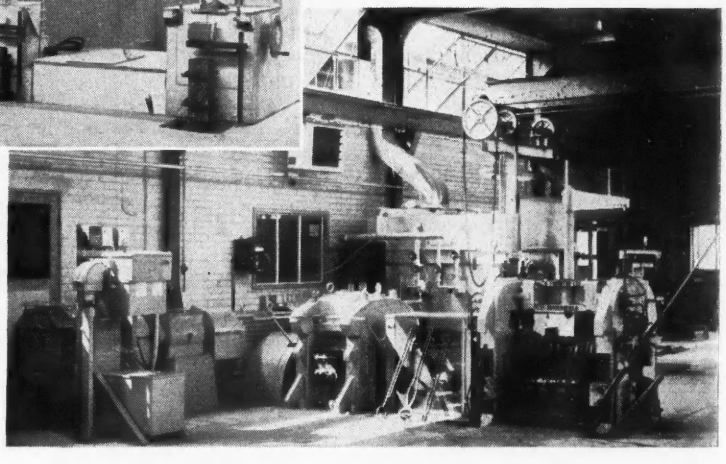
The mill is expected to fulfil three main functions. It will be used to roll ingots from the high frequency furnace into bars from which specimens will be made for metallurgical examination and mechanical testing, in the development of new alloy steels and steels for special purposes. It will also serve as a research tool for investigations into the manipulation of steel by rolling, e.g. roll pass design. The other application of the mill will be its use as a test rig for mill auxiliaries or, where practicable, particular problems arising in production mills.

At present, rolls are available for reducing $2\frac{7}{8}$in square ingots to $\frac{3}{4}$in or $1\frac{1}{8}$in diameter rounds and various intermediate squares. A further set of rolls will be available shortly for rolling $4\frac{3}{8}$in square ingots to $2\frac{7}{8}$in square billets, or various flats in thicknesses down to $\frac{1}{2}$in. The mill is equipped for the measurement of roll separating force, spindle torque and rolling temperatures.

The unorthodox practice of rolling a cast ingot to finished round in various qualities of steel with one set of rolls does not permit the rolling of precision products. It has been found possible, however, to produce a satisfactory bar for machining into test specimens.

The Laboratories were built at a cost of £250,000. A staff of 200 is employed, the work being divided into the following main sections:—Minerals, refractories, fuels and furnaces, iron and steel making plant, forming of metals, metallurgy, welding, chemistry, physics and mathematics. The Laboratories serve the various branches of the United Steel Companies which together produce $12\frac{1}{2}$ per cent of the country's iron and steel.

Three high frequency furnaces for experimental steelmaking at the Swinden Laboratories of the United Steel Companies



The 11in three-high experimental hot rolling mill with the gas-fired muffle furnace in the background

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Lighting Engineers' Salaries

I WISH to draw attention to the small salaries paid to lighting engineers employed by the manufacturers of lighting fittings. The illuminating engineering departments in which these engineers serve offer a free service which fulfils two functions: firstly, that of giving objective advice on lighting problems and, secondly, that of indicating the most suitable fittings in the catalogue.

The principal considerations which may influence employers in the determination of salaries are these:—"We offer a free service and therefore cannot pay other than small wages"; and "People will only seek work in this field if they are, from the outset, interested in the subject for its own sake, and therefore we need not pay other than small salaries to keep them."

If I am correct in this interpretation of employers' salary policies, then I am bound to point out that it is well within the power of manufacturers to make a charge for their professional services. The other suggestion, however cynical, may disclose an unworthy practice.

On the other hand, if I am wrong in these assumptions, I should like to remark on the great importance of this branch of the electrical industry as witnessed by the *Electrical Review* of 16th September, 1955, when the editorial and six articles dealt with the subject. The present scale of salaries is clearly not appropriate to work needing such skill and entailing such responsibilities.

To avoid causing embarrassment to my employers whose treatment is admirable in all other respects I should like to sign myself

LIGHTING ENGINEER.

[It may be mentioned that the issue referred to by the writer was our Annual Special Lighting Issue.—*Editors.*]

Domestic Electrical Usage

ARISING from the article on large-scale trials on an estate for C.E.A. staff published in your issue of 9th December, Mr. I. C. Harris commented in the subsequent week's issue on the existence of 400 V in the kitchen area.

The research panel under whose control the trials are carried out was, of course, aware of the relevant I.E.E. Regulations, and although the installations will be converted to standard single-phase, single-meter service at the end of the trial period of two to three years, special provisions have been made to minimize any possible risk by appropriately increasing the distance between cooker-control unit and washboiler socket-outlet, and equipping the lighting bracket over the cooker with an H.O.-type lampholder and a ceiling switch.

London, E.C.2. P. SCHILLER,
Commercial Department,
Central Electricity Authority.

Lighting With Heated Ceilings

FURTHER to the letter from your correspondent W. A. R. Stoyle in your issue dated 16th December, 1955, which referred to an article of which I was joint author, I wished to emphasize the importance of using equipment designed for the precise purpose of being installed in heated ceilings. Thus, well designed, correctly ventilated fittings allow every advantage to be given to the lamps and vacuum impregnated control gear eliminates any possibility of bitumen being exuded under conditions which could arise in a combination of high ambient temperatures and faulty lamps or starter switches.

I do not agree with Mr. Stoyle's remark that the efficiency of a tungsten lamp is unaffected by increasing temperature as one can sometimes come into contact with a hot air pocket in a badly ventilated fitting, resulting in a drop in lamp efficiency and a decrease in lamp life.

London, N.15. A. H. OLSON,
Managing Director,
Courtney, Pope (Electrical), Ltd.

Radioactive Isotopes

MR. E. ORLOFF'S letter in the *Electrical Review* of 30th December reminds me that in my article "Radioactive Isotopes" (9th December) I left the stable silicon atom in a positively charged condition. The positive charge would be neutralized in less than a microsecond by one of the free electrons in the mass of aluminium joining the charged atom.

The change from aluminium 27 to aluminium 28 takes place inside the pile, where there is a plentiful supply of free neutrons; the subsequent step from aluminium 28 to silicon 28 can take place either inside or outside the pile.

Abingdon, Berks. S. JEFFERSON.

News from Australia

From Our Perth Correspondent

The State Electricity Commission of Western Australia reports a surplus of £222,483 for the year ended 30th June last. This has enabled the Commission to clear the losses on its operations since 1949. Plant capacity at South Fremantle and East Perth power houses is now 100 MW (50 c/s) and 49 MW (40 c/s). At Bunbury the foundations and basement floor of the new power station have been practically completed. The hydro-electric power station foundations at Wellington Dam are also finished.

In Tasmania the demand for electric power is growing apace. Mr. H. D. Giddy, chairman of Australian Newsprint Mills, Ltd., says that his organization could considerably expand its output if additional power were available. "Forward planning is bound up closely with the extent and rate the Hydro-Electric Commission can extend its generating capacity," he says. "Our directors cannot again afford to face the position of a few years ago when our number two paper making machine lay idle for two years because the power contracted for was not available."

Commercial television in Australia is expected to begin in October next, with an initial 35 hours of programmes a week.

A Sydney housewife was recently arrested and sent to Long Bay Gaol for having failed to keep up hire-purchase payments on her refrigerator. She was imprisoned under a law, 100 years old, enacted before hire-purchase was known. A "detention clause" in her agreement meant that a customer could be sent to prison for letting payments lapse, but she was released the day after her arrest.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

H.R.H. The Duke of Edinburgh will be the principal guest at the annual dinner of the Institution of Electrical Engineers at Grosvenor House, London, on 23rd February. He will also accept the certificate of honorary membership of the Institution.

Philips Electrical, Ltd., announces the appointment of **Mr. A. L. Sutherland** and **Mr. H. C. White** as directors of the company.

Mr. Sutherland joined Philips in 1933 as lamp representative for West London, becoming lamp sales supervisor in 1937. In 1938 he was promoted head of the Special Lamps Department in which post he served until joining the army in 1940. He attained the rank of major, Royal Artillery, and held an appointment in the Air Branch of the General Staff. Upon rejoining Philips in 1946 he

Mr. A. L. Sutherland

Mr. H. C. White

managed the Tungsten Lamp Department until being appointed commercial manager of the Television and Radio Division in January, 1950.

Mr. White began his career with the company in 1929 as a representative in the West Riding. He was promoted area supervisor, attached to head office in 1934, and in 1940 returned to the North of England as manager of the Manchester Branch (now the North West Region). In 1949 he went back to London as commercial manager of the Lighting Division.

Sir Bernard Keen, D.Sc., F.Inst.P., F.R.S., is temporarily taking charge of the Research and Development Division of Baird & Tatlock (London), Ltd., following the death, reported in our Obituary Section, of Mr. S. J. Matthews, head of the Division.

Mr. S. F. Derbyshire will relinquish his post as general production manager of the British Aluminium Co., Ltd., on reaching the retirement age on the 17th February next. He will remain in a consultative capacity to the company for the time being. **Messrs. W. B. C. Perrycoste** and **J. Salter** will assume the posts of joint general production managers as from that date. The division of responsibilities will remain as at present. **Mr. P. T. Ensor** has been appointed as general manager of the Canadian British Aluminium Co., at Baie Comeau and this appointment has taken effect from 1st January. **Mr. A. R. Wylie** relinquished his post at the Lochaber Works of the company at 1st January on becoming works manager designate for the Canadian British Aluminium project at Baie Comeau.

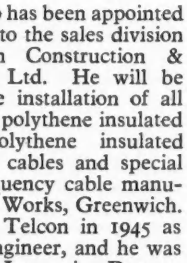
Mr. E. F. Wilkins has been appointed a director of the Rheostatic Co., Ltd.

Mr. H. Melhuish, a director of the Superheater Co., Ltd., has been appointed assistant managing director and head of the power plant division.

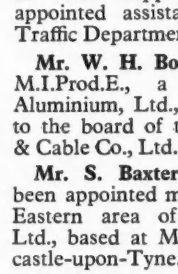
The Minister of Fuel and Power has appointed **Councillor E. H. Millington,** of Birmingham, **Mr. G. Rheam,** O.B.E., T.D., B.Sc., M.I.Mech.E., A.M.I.E.E., A.C.G.I., also of Birmingham, and **Mr. D. H. Thompson,** C.C., of Ledbury, Herefordshire, as members of the Midlands Electricity Consultative Council. **Mr. F. Edmondson,** M.Sc., M.I.E.E., M.I.Mech.E., A.M.Inst.C.E., of Sutton Coldfield, has recently retired at his own request on completion of his term of office.

Mr. H. W. Kemp has been appointed contracts engineer to the sales division of the Telegraph Construction & Maintenance Co., Ltd. He will be responsible for the installation of all types of paper and polythene insulated power cables, polythene insulated telecommunication cables and special types of radio frequency cable manufactured at Telcon Works, Greenwich. Mr. Kemp joined Telcon in 1945 as power cable test engineer, and he was previously with the Inspection Department of the Ministry of Supply at Chislehurst.

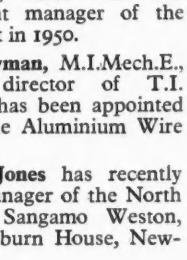
In giving the names in our last issue of men who were included in the New Year Honours List, we should have mentioned **Lt.-Commander G. C. Hans Hamilton,** chairman of the Expanded Metal Co., Ltd., who was appointed a Commander of the Order of the British Empire (C.B.E.), and **Mr. F. N. Judson,** industrial general sales manager of the Mobil Oil Co., Ltd., who becomes a Member of the Order (M.B.E.). We reproduce Mr. Judson's portrait herewith together with those of **Mr. G. W. Essex** of the C.E.A. (M.B.E.), and **Mr. W. R. Rose,** G.E.C. Telephone Works, Coventry (M.B.E.), who were mentioned in our last issue and whose photographs we have since received.



Mr. F. N. Judson

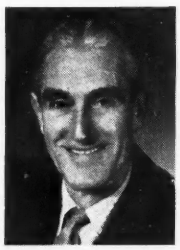


Mr. G. W. Essex



Mr. W. R. Rose

Following the death of Mr. Albert Mycoe, the Metropolitan-Vickers Electrical Co., Ltd., has appointed **Mr. J. C. Anderson** to be traffic manager. Mr. Anderson joined the Traffic Department of Metropolitan-Vickers (then British Westinghouse) in 1915, having been previously engaged in overseas shipping at Manchester, Liverpool and London. On the formation of the M-V Export Company in 1919 he was transferred to the London office in charge of the whole of the export shipping, but in the following year was recalled to the Trafford Park Works as chief shipping clerk. He was appointed assistant manager of the Traffic Department in 1950.



Mr. J. C. Anderson

Mr. W. H. Bowman, M.I.Mech.E., M.I.Prod.E., a director of T.I. Aluminium, Ltd., has been appointed to the board of the Aluminium Wire & Cable Co., Ltd.

Mr. S. Baxter-Jones has recently been appointed manager of the North Eastern area of Sangamo Weston, Ltd., based at Milburn House, Newcastle-upon-Tyne.

Mr. Leslie C. Sharp was installed last week as Master of the Worshipful Company of Clockmakers. The ceremony was performed by the Deputy Master, Sir Harold Spencer Jones, the retiring Astronomer Royal. Mr. Sharp will be remembered as a former chairman of the Court of the

E.I.B.A., of the Meter Manufacturers' Association and B.E.A.M.A. Meter Section. He and his father, the late Mr. E. E. Sharp, were directors of Venner Time Switches, Ltd. (now Venner, Ltd.), for many years. Mr. Leslie Sharp is now managing director of Dimafon, Ltd., makers of dictating machines, etc.

The Brush Group, Ltd., announces that owing to ill-health **Mr. S. A. Lane** has relinquished his executive responsibilities and has tendered his resignation as a director of the company. His services will continue to be available to the company and its subsidiaries in a consultative capacity.

Mr. D. P. C. Neave, vice-chairman of the Consolidated Zinc Corporation, Ltd., has been elected chairman of the Zinc Development Association. The former chairman, **Mr. William Mure,** managing director of the British Metal Corporation, Ltd., will continue as a member of the Council of the Association.

Mr. J. B. Mavor has retired from the chairmanship of Mavor and Coulson, Ltd. **Mr. J. D. Lloyd** has been appointed joint managing director in succession to the late Mr. E. I. Mavor and **Mr. R. J. Hird,** director and chief engineer, has become works director. The appointment of a new chairman will be decided later.

Mr. E. M. Whitaker, B.Sc., A.M.I.E.E., author of the article on Prospects in Argentina (page 67), is manager of the Buenos Aires office of the British Thomson-Houston Co., Ltd. He was educated at Leeds University and joined the B.T.H. Co., Rugby, as a sales engineer in 1937. From 1942 to 1946 he served in the R.E.M.E., attaining the rank of major. In 1947 he went to Buenos Aires as assistant manager of the B.T.H. office in that city and remained there until 1951. From 1951 to 1953 he was district engineer and representative of the company in Colombia, Ecuador, Venezuela and Trinidad. He returned to Buenos Aires as manager in 1954.

Mr. E. M. Whitaker

Mr. S. W. Harrison, a member of the Switchgear Department of Brush Electrical Engineering Co., Ltd., Loughborough, has been nominated as the town's next Mayor.

Mr. R. B. Sennitt, London manager of the Hotpoint Electric Appliance Co., Ltd., has retired. To commemorate his twenty-three years' service he was recently presented by his colleagues, past and present, with a motor lawn mower. In addition he was presented with an oak casket enclosing a gold blocked Spanish leather autograph album containing some 120 signatures collected from all the company's district offices and works. Mr. O. H. Buckingham (director) made the presentation.

At the annual dinner-dance of the Nottingham Branch of the E.I.B.A.: Mrs. and Mr. T. H. Greaves, Mrs. and Mr. E. W. Davies, Lady Bishop, Mr. and Mrs. C. R. King and Sir Harold Bishop

The Phœnix Telephone & Electric Works, Ltd., has appointed **Mr. L. W. Hale** and **Mr. P. H. Lovell** as joint managers of its branch at Newman Street, London, W.1. Mr. Hale, who has had twenty-two years' service with the company, will devote his time to customer liaison, and Mr. Lovell, who has been with the company for seventeen years, will be responsible for internal administration.

Rear-Admiral (E) I. G. MacLean, C.B., O.B.E., has joined the Brush Group, Ltd., as director of marine development, in which capacity he will act as technical adviser to the Group in regard to design and development of equipment for marine purposes. He recently retired from the post of deputy engineer-in-chief of the Fleet, which he had held since 1952.

Mr. H. T. Sayer, engineer-in-charge of the Croydon establishment of Marconi's Aeronautical Division, has retired. Mr. Sayer has completed over forty years' service with the company, thirty-two years of which have been spent more or less continuously with the Aeronautical Division, mainly at its Croydon establishment. His successor is **Mr. W. L. Munday.**

The annual general meeting of the **E.I.B.A. Manchester and District Branch,** will be held on 30th January at the Engineers' Club, Albert Square, Manchester, commencing at 5.45 p.m.

Mr. E. W. Davies, chairman of the Nottingham Branch of the **Electrical Industries Benevolent Association,** presided at the branch annual dinner-dance in Nottingham on 7th January. Mr. Davies outlined the activities of the Nottingham Branch and thanked all helpers. Replying, Sir Harold Bishop, president of the Association, said that Nottingham was one of the oldest branches and he congratulated them on having such an energetic committee.

Among the 150 guests were Mr. C. R. King, chairman of the East Midlands Area Committee and past national president, and Mr. T. H. Greaves, past-chairman, who was toastmaster. The M.C.s were Messrs. J. D. Furse and J. H. Fletcher.

Mr. R. Wallace, commercial director, **Brookhirst Switchgear, Ltd.,** Chester, stressed the importance of the welfare of apprentices at the annual meeting and prizegiving of the Apprentices' Association on 4th January. He said that although the electrical industry in this country faced a bright future, there was increasing danger of a shortage of skilled scientists and engineers. This country was already falling behind the United States and Russia. Mr. J. O. Knowles (director), presented prizes and awards which included the chairman's gavel (presented annually to the chairman of the Apprentices' Association) to Mr. H. M. C. Day.

At a sales conference held in London on 4th and 5th January, Mr. H. G. Campbell, joint managing director of the Benjamin Electric, Ltd., presented **Mr. C. W. Embers,** sales engineer, with an engraved gold wrist watch, given as an award of merit to the outstanding member of the company's sales force. Mr. Campbell made the presentation on behalf of his father, Mr. Guy Campbell, chairman of the Benjamin

Mr. H. G. Campbell (left), joint managing director of the Benjamin Electric, Ltd., making the presentation to Mr. C. W. Embers

Electric. Mr. Embers has been a member of the sales force of the company for nineteen years.

The **British Central Electrical Co., Ltd.,** held its annual Christmas party for directors and staff on 16th December at the Eccleston Hotel, near Victoria, when nearly sixty sat down to dinner. A bouquet was presented by the staff to Mrs. Gordon Conradi, wife of the managing director, and a cable was read from the chairman, who was unavoidably absent in New York. Following dinner there was an excellent cabaret provided by Barry Manning and his Champagne Follies. Mr. Gordon Conradi made a presentation to Mr. John Goddin, who had reached his seventieth birthday and was shortly due to retire. The rest of the evening was devoted to dancing and party games.

At the annual staff ball of **Marryat & Place, Ltd.,** held at the Bonnington Hotel on 30th December, eight gold wrist watches were presented by Mrs. Marryat to employees who have completed over thirty years' service with the company. In addition, a television receiver was presented to Mr. H. G. Gwinnell, and a set of nesting tables and cut glass table service to Mr. J. G. Cant, manager of the Lift Maintenance Department, both of whom have served the company continuously for over forty-five years.

At last Tuesday's luncheon of the **Electrical Industries Club,** the principal guest was Sir Graham Hayman, president of the Federation of British Industries. He was introduced by Mr. Leslie Gamage, the president of the Club, and gave an address outlining some of the problems confronting Great Britain on the "home front" and mentioning possible remedies. Sir Graham was thanked by Mr. J. Oldroyd, secretary of the B.E.A.M.A.

Mr. Gamage mentioned that the speaker at next month's luncheon (Connaught Rooms, 14th February) would be Mr. C. Holford Reddish, chairman of the Rugby Portland Cement Co.

On Saturday last at the Clarendon Restaurant, Hammersmith, the West London Branch of the **Association of Supervising Electrical Engineers** held its annual dinner and dance, and some 150 members and friends enjoyed a very pleasant evening. The toast of "The Ladies" was proposed by Mr. E. A. Bromfield, the general secretary of the Association, with a response by Mrs. R. F. Twentyman. The "West London Branch" was proposed by Mr. R. F. Mathieson, who paid tribute to the efforts of Mr. J. H. K. Pendry, the present branch chairman and former branch secretary, to whom, he said, the success of the function was due. Mr. Pendry, in his reply, said that it gave him great pleasure to see the dinner and dance develop into one of the principal social events in the A.S.E.E. calendar. Mr. Pendry presented the past chairman's certificate to Mr. J. M. Harding who, in turn, presented Mr. Pendry with a past secretary's certificate in recognition of his twelve years in that office.

OBITUARY

Mr. S. J. Matthews, head of the Research and Development Division of Baird & Tatlock (London), Ltd., died in his office on 2nd January.

WILLS

Mr. G. Ellison, chairman of George Ellison, Ltd., and of Alfred Ellison, Ltd., who died on 17th July, left £89,311 gross (£84,993 net).

Mr. J. Scrivener, former managing director and vice-president of Electrolux, Ltd., who died on 8th September last, left £45,939 gross (£43,489 net).

Alderman H. A. Cruse, C.B.E., former director and general works manager, Westinghouse Brake and Signal Co., Ltd., who died on 18th September last, left £15,096 gross (£14,189 net).

Mr. W. J. Rawlings, chairman of Rawlings Bros., Ltd., and a director of the Rawlplug Co., Ltd., and associated companies, who died on 10th October last, left £40,131 gross (£34,221 net).

Mr. H. Hillier, O.B.E., engineering and technical director, G. & J. Weir, Ltd., Glasgow, who died on 27th August last, left personal estate in England, Scotland and abroad valued at £251,727.

ALUMINIUM SOLDERING TECHNIQUE

Current soft soldering technique for jointing aluminium usually relies on heavy and expensive soldering tools whether mechanically or electronically operated, and 90 per cent tin, 10 per cent zinc alloy solder is usually employed. In view of the difficulties involved Tiltman Langley Laboratories, Ltd., have, under a Ministry of Supply development contract, made an investigation into aluminium soldering.

Although the research programme is continuing, the company has developed a soldering tool which is easily manipulated, light and cheap and capable of being used for fluxless soldering of aluminium with any normal solder used for this purpose. The possibilities of soldering aluminium at 250 deg C have also been investigated with a solder developed by Tiltman Langley for making corrosion resistant joints in high strength aluminium alloys or cold worked aluminium without appreciably weakening the alloys being joined.

The equipment used comprises a hand tool and an electric hot plate for raising the work to the soldering temperature. The technique is to apply the solder and lightly brush the surface being tinned with a guarded refractory brush on the tool, any of the usual cleaning techniques having been previously applied to the aluminium; no flux is used. After tinning the surfaces to be joined are placed together and a neat fillet of solder produced by sweeping through the molten solder with the refractory brush. Experience has shown that this implement used manually or mechanically, is more universal in its application than other soldering tools for use on aluminium. It is also less damaging to the surface than other tools.

The solder, which has been subjected to salt spray and humidity tests, has shown good corrosion resisting properties in aluminium soldered joints; it also has good mechanical properties. After being raised to a soldering temperature of 250 deg C for a short time, no appreciable loss of mechanical properties is experienced in the majority of aluminium alloys. A shear strength of 2½ tons/sq in is obtained in such soldered joints.

Tiltman Langley refractory brush for soldering aluminium

NEW DRY BATTERY

The Burgess Battery Company, of Illinois, U.S.A., has recently developed a new "wafer cell" dry battery which consists of a sandwich of artificial manganese dioxide mixture between tiny discs of flat zinc and carbon electrodes. The old carbon rod of round cell batteries has been supplanted by a small piece of conductive carbon, and the whole sandwich is swiftly machine-wrapped in an airtight pliofilm envelope and heat sealed.

Welded or soldered wire connections between cells are eliminated by the use of silver wax, a new conductive wax intercell connection developed by the company. A dab of silver wax on the positive and negative sides of the cell permits the cells to be connected in series merely by being stacked in a column, and a multiple cell battery results from the electrical contact established between cells by the wax in pressure contact. Rigid intercell connections are maintained even under rough handling since the silver wax yields and moulds itself to any configuration between the cells necessary to hold perfect electrical contact.

Power Station Auxiliaries

DECISIONS AT THE PLANNING STAGE

AT a joint meeting of the Institutions of Electrical and Mechanical Engineers on 6th January, Messrs. Geoffrey F. Kennedy and F. J. Hutchinson (Kennedy & Donkin) discussed aspects of auxiliary services that entailed decisions at the planning stage of interconnected power stations containing units of 60 MW and above.

Power consumption of some services, they stated, was almost constant per kW installed, irrespective of the type of plant. For others it varied substantially with steam conditions, vacuum and steam cycle, but not very greatly with type of plant. The designer could, therefore, estimate the requirements at once.

The quantity of feed water at turbine continuous maximum rating could be derived from the typical figures given in Table 1. These figures were based on a 29in vacuum; for 28·6in Hg (as with cooling towers) steam consumption was from 2 to 3 per cent higher; a single feed pump scheme was employed for 60 and 100 MW and a split arrangement for 120 and 200 MW units. To the pumping head needed to overcome boiler pressure must be added that to overcome static head (usually 60ft or more above firing floor) and resistance of the feed circuit, made up of pipes and valves, feed heaters and regulators, economiser and superheater. The circuit resistance being unknown at the initial stage called for the provision of a margin; excess head could reduce station efficiency by nearly 1 per cent.

Boiler-fan power could be approximately obtained from the formula

$$P_f = \frac{0{\cdot}14(460+T)}{\eta_o} \times \frac{ad}{\eta_f} \times 10^{-4}$$

P_f being the input to the fan as a percentage of unit capacity; to obtain the input to the fan motor, P_f must be divided by the motor and coupling efficiency. Secondary variables for sets up to 120 MW without margin for uncertainty were also given (see Table 2). Power taken by the forced-draught fans was usually up to 0·3 per cent of the station output and by induced-draught fans up to 0·6 per cent.

Pumping power for circulating water systems was given as in Fig. 1 as a percentage of unit output; figures for cooling-tower stations included static head, but river and estuary stations were assumed to have syphonic c.w. systems. Upper and lower limits for each curve depended upon the resistances of the condensers and the external pipework. Higher temperature ranges became economical as unit sizes increased, being typically from 12 to 17 deg F for 60 to 120 MW turbines for river and estuary stations and from 17 to 21 deg F for cooling-tower stations. Cooling towers were usually operated most economically with a c.w. bus-main which permitted easy control of water circulation, all towers being kept in commission irrespective of the number of pumps running.

Pulverizing mills (including exhausters or blowers and feeders) consumed from 15 to 25 kWh/ton of coal, varying with the quality of coal; with a calorific value of 10,000 B.Th.U./lb and a thermal efficiency of 34·5 per cent, the power required would be less than 1 per cent of the output of the unit.

Alternator fans might take up to 0·8 per cent of station output and coal and ash handling up to 0·5 per cent. Lighting, heating and other services had a high diversity and their simultaneous demand was unlikely to exceed 0·4 per cent of the station output. The total m.d. made by essential services would probably be from 5·5 to 6·5 per cent of station output and the corresponding range for non-essential services 0·4 to 0·7 per cent.

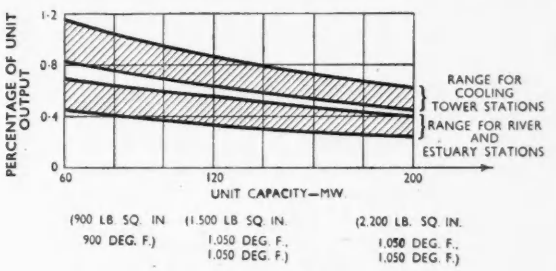
Four sources of auxiliary power had been used in the past, viz.: separate turbine-driven house generators; unit generators coupled to each main turbo-alternator shaft; unit transformers connected to the generator terminals; station transformers supplied from the busbars connected to the main generator transformers. Only the last method or the last two methods in combination need be considered in future. Table 3 indicated the comparative costs of three schemes. The secondary voltage of auxiliary transformers was determined by the maximum carrying capacity for standard switchgear (1,200 A, B.S. 116). With 60 MW units 3·3 kV would serve, and with 120 MW units 6·6 kV;

TABLE 1.—POWER REQUIREMENTS OF FEED PUMPS FOR TYPICAL CONDITIONS

Unit capacity, MW	60	60	100	120	200
Turbo-alternator efficiency ratio, per cent	78·6	80·5	80·8	80·8	82·0
Initial steam: turbine stop valve pressure, lb/sq in gauge	900	1,350	1,500	1,500	2,350
Temperature, deg F	900	950	1,050	1,000	1,050
Reheat temperature, deg F	—	—	—	1,000	1,000
Feed temperature, deg F	385	450	450	435	472
Steam consumption, lb/kWh	8·42	8·20	7·85	6·38	6·32
Efficiency: feed pump, per cent	77	77	79	79	81
,, feed-pump motor, per cent	94	95	96	96	97
Input to feed-pump motor as percentage of unit capacity to overcome stop-valve pressure only, per cent	0·95	1·35	1·57	1·26	1·97

TABLE 2.—SECONDARY VARIABLES FOR BOILER FANS

Symbol	Quantity	Upper Limit	Lower Limit
a	Excess air ratios:		
	For forced-draught fan	1·30	1·20
	For induced-draught fan	1·60	1·30
d	Pressure drop in inches of water gauge:		
	For forced-draught fan, inches	7	4
	For induced-draught fan, inches	10 (with reheat)	5 (without reheat)
η_o	Overall thermal efficiency of station	0·35	0·28
η_f	Fan efficiency	0·85	0·75



Power required by auxiliary water pumping systems

TABLE 3.—COST OF TRANSFORMERS FOR AUXILIARY SUPPLIES FOR STATION WITH SIX 120 MW UNITS

Item		Unit Transformer	Station Transformer Schemes	
			With Standby	Without Standby
	Scheme particulars:			
(1)	Number and MVA rating of station transformers... ...	2×15	2×60	2×30
(2)	Number and MVA rating of unit transformers	6×10	—	—
(3)	Extra load on step-up transformers, MVA	Datum	46	46
	Estimated costs:			
(4)	Station transformers, £ ...	40,000	97,000	58,000
(5)	Unit transformers, £ ...	60,000	—	—
(6)	Capitalized cost of auxiliary transformer losses, £ ...	111,000	83,000	93,000
(7)	Capitalized cost of losses introduced by extra load on step-up transformers, £	Datum	75,000	75,000
(8)	Total capitalized cost, £ ...	211,000	255,000	226,000
(9)	Estimated cost of unavailability, £	Datum	15,000	100,000
(10)	Grand total (=(8)+(9)), £ ...	211,000	270,000	326,000

for 200 MW units and above 11 kV might be necessary. Choice of voltage would not be influenced by rupturing capacity. Feed pumps, c.w. pumps and boiler fans would be supplied at the above voltages and the remaining motors would be wound for 415 V.

Various methods of auxiliary control and the economics of numerous designs and arrangements of plant were considered in detail.

DISCUSSION

The discussion was opened by Mr. Llewellyn Young, who doubted whether totally enclosed centralized control rooms, even with television, distance control and automatic control, could provide a completely satisfactory substitute for visual observation.

Use of the "console panel" necessitated reduction in size of indicating instruments to permit of housing within a reasonable space. A great part of the panel space was occupied by motor control switches and push-buttons. Important operational readings were reduced to a scale of perhaps 4in, whereas control switches and push-buttons of a type suitable for the hand-firing stoker were still standard equipment.

Commander L. Baker said there was a real hazard in centralized control. Applied psychologists had established that the ability of even a highly intelligent and fully trained man was surprisingly limited, and in the future the man on the spot would not be able to deal with a crisis because his brain was overloaded. A safety shut-down in the event of failure should be followed by analysis of records of the sequence of failure so that the fault could be eliminated before restarting.

Mr. H. S. Horsman said that either variable-speed motors or inlet vane controls for fans provided opportunities for the use of automatic control and automatic shop technique. Like the author he would, in British circumstances, avoid coupled alternators and house sets.

Mr. H. Dickin presumed that the authors, in assessing the total cost of variable-speed commutator motors had included the associated induction regulator. The additional cost of housing the induction regulator was large, and it was rarely convenient to place it at the motor.

Mr. C. E. H. Eckersley had found that all essential information was seldom given to manufacturers to enable them to put forward the most suitable equipment for a job. For instance, the fan manufacturer was usually asked to put forward a number of quotations to cover various alternatives in draught loss and air and gas volume caused by alternatives in economizers, air preheaters, dust collectors, various forms of fan drive and the like. He was, however, rarely given the load factor, planned overall station efficiency, cost of fuel, life of plant and interest rates, which information would have saved time and cost in tendering.

Mr. F. B. Johnson suggested that while central direction of all control operations, using where necessary some system of communication, was desirable, provision for remote operation of every control was not so clearly profitable. The Central Electricity Authority for a number of years had specified the use of telemetering equipment to avoid bringing high-pressure steam and water connections into control rooms.

Mr. L. Spiro considered that the commissioning of nuclear power stations would ultimately confine even the largest units in coal-fired stations to two-shift operation, and that might bring about wider use of variable-speed drives. That would present no major problem, particularly when all the required speed variation could be concentrated on the booster pump.

Mr. L. Lamb said that in his experience the cost of the two-speed drive had been lower than that of the variable-speed commutator motor for induced-draught fans because of its lower price and higher efficiency. He agreed with the authors, however, that damper control even in conjunction with two-speed motors was not economical.

Mr. J. L. Gray also referred to the development of large-scale nuclear generation as necessitating design of all conventional stations for two-shift working. That had been a decisive factor in the adoption of variable-speed drive for the boiler feed pumps of future 200 MW units. In general terms, a variable-speed drive would be profitable in 60 MW or larger units, but the net cost of the simple reliable constant-speed drive for smaller units was not too great to be borne, even if economics were a sufficient criterion. A variable-speed device increased the probabilities of failure and of failure to start in emergency, thereby justifying greater expenditure on standby.

Mr. D. A. Dewison submitted that choice of voltage was not entirely determined by the maximum current-carrying capacity of standard switchgear. Cost was important, and his investigations suggested that for 120 MW units the cost was marginal between 3·3 kV and 6·6 kV. The choice would depend on the number of sets required to be started simultaneously, the relative costs of switchgear, motors and cables, and the volt drop when starting a boiler feed pump. Those factors influenced the size and percentage reactance of the station transformer, the MVA and current rating of the switchgear and hence the voltage. He agreed that the intermediate voltage scheme should be avoided if possible.

Music Transmission Over Radio Links

In a paper presented before the Institution of Electrical Engineers' Radio Section on 11th January, Mr. R. F. Rous (General Electric Co.) described a communication system which combined three music circuits and an engineering circuit by using pulse-time modulation in four time-division multiplex channels. A single microwave link intended for transmitting television signals, it was stated, could thus carry audio signals as an alternative. Performance figures, set out in detail, indicated better results than those recommended by C.C.I.F., principally in regard to signal-noise ratio and harmonic distortion. In the first the margin was 20 dB above the recommended values over a 25-mile radio link, which allowed for fading. The use of pulse-time modulation ensured that the radio link need not have an extremely linear amplitude response.

INDUSTRIAL NEWS

Electricity Supply Superannuation Funds

A settlement is expected shortly in the long-standing dispute between the Central Electricity Authority and the local authority associations about the transfer to the electricity authorities of assets from superannuation funds of local authorities formerly owning electricity undertakings.

This relates to the Councils' liability under the Electricity (Pension Rights) Regulations, 1948, in respect of employees who, as a result of the operation of the Electricity Act, 1947, became employees of the Electricity Boards.

The question at issue is whether the fall in the value of assets since vesting date, 1st April, 1948, should be borne by local authorities' superannuation funds or be reflected in the amount of assets transferred. The Association of Municipal Corporations is now reported to have suggested to its members a basis of settlement of outstanding claims which is considered to be an equitable one.

American Contract for Ferranti

Last week we reported that Ferranti, Ltd., had been awarded a further contract by the Corps of Engineers, U.S. Army, for twenty-one large power transformers, valued at $2,080,940. The company says that this is the largest order for transformers so far to be placed in Great Britain by the United States.

The contract covers eighteen 63,000 kVA, 230 kV single-phase transformers and three 63,000 kVA, 115 kV single-phase transformers for the Dalles Dam project, Columbia River, on the borders of Washington and Oregon. The transformers will be of the forced-oil, forced-water-cooled, inert-gas-filled type, and each will weigh approximately 73 tons. Delivery is to commence next year and be completed early in 1960.

This contract, the fifth awarded to Ferranti, Ltd., by the U.S.A. in recent years, brings the total number of transformers supplied or under construction to 38 units with a total capacity of 1,972,000 kVA and a value of $3,827,000 (£1,366,785).

Careers in Atomic Energy

At present Britain is well to the fore in atomic energy developments but the United Kingdom Atomic Energy Authority is faced with the responsibility of furthering these developments at a continuously increasing rate and of training British industry to meet the challenge of the future. As it is a young and expanding organization its work has a special appeal for young people and an interesting 24 page illustrated booklet has been produced in an effort to make more widely known one way of joining the Authority: through the apprenticeship schemes. The booklet describes the types of apprenticeships open to young men and outlines the schemes of training and remuneration which they would be given depending upon their particular interests. Copies of this booklet may be obtained from the Chief Labour Officer, United Kingdom Atomic Energy Authority, Bedford Chambers, Covent Garden, W.C.2.

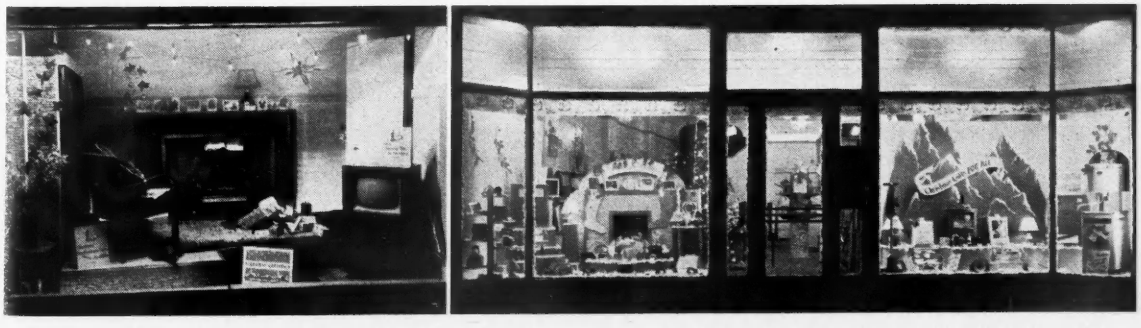
Y.E.B. Window Display Competition

As in previous years a window display competition was held during the Christmas season for all the service centres of the Yorkshire Electricity Board. For this competition the service centres are divided into two classes—class "A" with a large amount of window space and class "B" with a smaller amount. In addition, consideration is given to the general use made of all available window space and not just the one window. Sub-Area managers were asked to choose one service centre in each class in their Sub-Area for entry into the area competition. These selected entries were judged by Mr. S. Agnew Mercer, a director of Tattersall Advertising, Ltd., Harrogate, and the chief commercial officer. In class "A" the service centre at Huddersfield was awarded the first prize and that at Ferensway, Hull (last year's winners), the second prize. In class "B" the first prize was won by Otley and the second prize by Stocksbridge. The first prize in each class is a silver cup which is held for a year and the second prize winners receive certificates of merit.

Colliery Winder Orders

The General Electric Co., Ltd., has received an order from the National Coal Board for a double drum electric winder to be installed at the No. 1 shaft of Cadeby Colliery in the Board's North Eastern Division, No. 3 Area. The winder will have two drums, 16ft diameter by 4ft wide, and is designed to raise coal from a depth of 2,280ft, the drum speed being 46·9 r.p.m. with a skip load of 4·34 tons per wind, giving an hourly output of 160 tons. A 2,250 h.p. a.c. motor, which will be manufactured at the Witton Works of the company, will drive the winder through single-reduction gear. An 18ft diameter by 5ft wide double drum winder is already undergoing erection at Cadeby Colliery to serve No. 2 shaft. This machine has been designed to raise 12 tons of coal per wind from a depth of 2,299ft, giving an hourly output of 525 tons. The Witton Works of the G.E.C. supplied the 3,700 h.p. d.c. motor for this winder.

The G.E.C. has also received orders from the N.C.B. for two 4-rope friction winders to be installed at the No. 6 shaft now being sunk at New Monckton 1 and 2 Colliery in the No. 4 (Carlton) area of the North Eastern Division. Both winders have drums of 10ft diameter. One of them is designed to raise coal at the Melton Field level from a depth of 1,065ft. With a drum speed of 50 r.p.m. the coal load will be 10 tons per wind. The second winder will raise a coal load of 10 tons from a depth of 1,545ft



One of the show windows of the Huddersfield Service Centre which was awarded first prize in the class "A" competition of the Y.E.B., and (left) the display by the Otley Service Centre which was awarded first prize in class "B"

at the Barnsley level. Both winders will be driven by a single 0/1,550 h.p. 500/0/500 r.p.m. d.c. motor. The excitation for the field of each motor will be provided by a constant voltage exciter, while the armature will be supplied by means of a Ward-Leonard set comprising a 0/1,040 kW 0/700 V generator driven at 740 r.p.m. by a 1,250 h.p. 11 kV slipring motor. Control of the speed of the winder motors will be effected by means of control exciters connected in the field circuits of the Ward-Leonard generators. The whole of this electrical equipment, together with the associated control gear, will be manufactured at the G.E.C. Witton Works.

Company's Telephone Network

A new telephone network link for the five factories in the Brighton area of C.V.A. Jigs, Moulds & Tools, Ltd., including the sales organization, E. H. Jones (Machine Tools), Ltd., went into operation recently. The new network enables members of the staff in any part of the C.V.A. group to dial each other direct or make external calls—all from the same telephone. The nerve-centre of the system, which has been provided by engineers of Automatic Telephone & Electric Co., Ltd., in collaboration with the Post Office, is a 200-line P.A.B.X. No. 3, the latest type of private automatic branch exchange. In addition to the main exchange, situated at the Group's administrative centre, adjoining the main factory at Portland Road, Hove, 100-line satellite automatic exchanges have been installed at two neighbouring factories. The first is at the No. 2 factory four miles away in the new industrial area of Hollingbury; the other serves factory No. 3 at Coombe Road, Brighton. These fully automatic, unattended, exchanges are linked to the main works by private G.P.O. lines.

Swiss Electrical Exports

Mr. R. E. Kaan, the author of the article on "Swiss Industry and Trade" published in our last issue, says that the item "Mercury arc rectifiers" in the table of Swiss electrical exports should be "Electrical apparatus including mercury arc rectifiers."

Canadian Market for Nickel Cadmium Batteries

After only two years of sales exploitation in Canada, Nife Batteries, of Redditch, Worcs, has received orders to the value of $500,000. Development of this market was restricted until about two years ago by home demand for these batteries for defence purposes but, as soon as the pressure eased, Nife Batteries sent one of its senior engineering staff to Canada to carry out a coast-to-coast survey. After three months, it became apparent that there were excellent prospects, and the British General Electric Co. (Canadian), Ltd., were appointed sole agents for the territory. Special literature was prepared to cater for the different technical specifications of the Canadian market and many special tests were carried out to determine battery characteristics at extremely low temperatures. Inquiries were received from electricity supply, railway, mining and industrial concerns and a number of trial orders were booked and executed. One important inquiry was received from the Canadian Government for the supply of nickel cadmium batteries which could withstand severe transport conditions to isolated sites, resist extremely low temperatures and operate vital equipment without fail after prolonged periods without skilled maintenance or attention. Special battery designs were also produced and despite intense competition from Canadian, American and Continental companies, an initial order for $125,000 was received. Successful operation of these units led to a repeat contract for $100,000. At the same time, orders were being received from electricity supply undertakings and general industry to the value of some $300,000.

Cables for New Zealand

The *Board of Trade Journal* reports that the New Zealand Customs Department has announced a 10 per cent increase in the permitted imports during 1956 of insulated wires and cables, copper and tinned copper wire, etc. Additional licences will be issued to firms already granted 1956 licences for amounts less than they applied for. Applications from concerns who have already been allowed the full amount applied for will be considered for additional licences upon application to Collectors of Customs.

Higher Efficiency Mercury Vapour Lamps

Improved performances for their 250 W and 400 W mercury vapour discharge lamps are announced by a number of lamp manufacturers, including Crompton Parkinson, Ltd., the British Thomson-Houston Co., Ltd., and the General Electric Co., Ltd.

"Resuscitation After Shock"

In the caption to the illustration of the article bearing the above heading in last week's issue (p. 6) the use of the term Holger-Nielsen was incorrect. The picture showed the application of the *rocking* method of resuscitation.

Abnormal Indivisible Loads

Proposals by the Minister of Transport and Civil Aviation to revise the law with a view to imposing further restrictions on the movements by road of abnormal indivisible loads, were discussed at a meeting held on 20th December when representatives of the Heavy Haulage Group Committee of the Road Haulage Association and representatives of a number of organizations concerned with those movements exchanged views on this subject. The meeting examined the implications of the Minister's proposals and felt that they would inevitably impose serious restrictions and delays on important industries, without relieving traffic congestion. Although the organizations concerned will submit separate independent observations, the meeting generally agreed that the Minister's proposals were unacceptable.

The organizations represented included the British Electrical and Allied Manufacturers' Association.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM Ingots	ton £179 0s 0d
COPPER, H.C. Electro	ton £393 5s 0d
Fire Refined 99·70%	ton £392 0s 0d
Fire Refined 99·50%	ton £391 0s 0d
COPPER Tubes ..	lb 3s 8½d
Sheet	ton £459 10s 0d
H.C. wire and strip ..	ton £434 15s 0d
LEAD, English ..	ton £121 5s 0d
Foreign	ton £120 0s 0d
MERCURY	flask £88 15s 0d
TIN, block (English) ..	ton £830 10s 0d
ZINC, G.O.B. Foreign	ton £104 0s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)..	lb 2s 11⅛d
Sheet	ton £358 15s 0d
Wire	lb 3s 6⅛d
PHOSPHOR BRONZE Wire	lb 5s 3½d
PLATINUM	oz £32 10s 0d
RUBBER, No. 1 R.S.S. spot	lb 34½d—34⅝d

Cranes for Humber Docks

A £2,000,000 Humber docks improvement programme announced by the British Transport Commission includes the provision of six 3-ton and three 6-ton semi-portal electric cranes with 60ft radius at Riverside Quay and eight 6/3-ton and one 10-ton semi-portal electric cranes (60ft and 45ft radius, respectively) for South Side, Albert Dock.

Electrical Fatalities in N.S.W.

Seventeen more people died from electric shock in New South Wales in the first ten months of this year than in the whole of 1954, reports our Sydney correspondent. The worst year previously had been 1952 when 35 people were killed compared with 37 so far this year. Defective household appliances and ignorance of the dangers of electricity are stated to have been the chief causes.

Statistics compiled by the Electricity Authority of New South Wales show that in the last ten years 96 people died from electric shock in their homes. In the same period ten people, mostly children, died through touching power lines.

The chairman of the Electricity Authority, Mr. V. J. F. Brain, said that he was concerned at the increase in deaths by electricity. The Authority

was continually striving to reduce electricity accidents, and apart from enforcing standards for electrical wiring work and the design of appliances, it had endeavoured to educate the public in the precautions to be observed. Most electricity accidents in and about the home were the result of a defect in the flexible cord or a cord fitting, such as a three-point plug, cord extension socket or appliance plug. Frequently the fatal shock is received only because the victim attempts to make a repair or adjustment without first switching off at the power point and pulling out the plug. No matter how easy home electrical repairs might appear, householders should not attempt to do them, Mr. Brain said. He also urged householders to have their equipment checked regularly by qualified electricians.

Venezuelan Public Works Programme

Some measure of the opportunities for exporters to Venezuela can be gained from an examination of a programme of public works for the ensuing twelve months, costing over 1,000 million bolivars (approximately £100 million), which was inaugurated by the President of the Republic, General Marcos Perez Jimenez, early in December.

The programme includes expenditure of 93·2 million bolivars on the telegraph and telephone services and 16·7 million bolivars on electrical development.

Kampala Agricultural and Trade Show

At an agricultural and trade show held in the Nakivubo Stadium, Kampala, Uganda, from 15th to 18th December, the Uganda Electricity Board had a stand displaying a wide range of electrical appliances of interest chiefly to the domestic, commercial and workshop type of consumer.

Throughout the four days the show attracted large crowds whose interest was held in particular by the continuous demonstrations of various appliances by native men and women who could explain the appliances in the local language. Cookery demonstrations in a hall at the back of the stand were a great success, as were the film shows in between cookery demonstrations. Coffee was served to the audiences and on the refrigerator section of the general stand cold drinks were always popular.

Norway Buys British Transmitters

Congestion existing in the low- and medium-frequency bands is causing many broadcasting authorities to make more use of the very high frequencies. The latest authority to do so is the Norwegian Telegraph Administration, which has placed an order with Marconi's Wireless Telegraph Co., Ltd., for eleven Marconi 5 kW frequency-modulated v.h.f. broadcasting transmitters and a quantity of phasing equipment. The transmitters to be supplied are of a new design; their simplicity in operation will make them particularly suitable for unattended working. The contract was obtained by Marconi's through their Norwegian agents, Norsk Marconikompani A/S.

P.O.A. Report

The Purchasing Officers' Association has issued the annual business report prepared by the Economic Survey Committee of the Association in which the general industrial trend in 1955 is reviewed. It deals with the need for greater production to meet the demands for higher wages, the fluctuations in the prices of commodities, such as copper, tin, lead, zinc and rubber, the shortages of steel, brass stampings, nickel and other commodities, and the labour situation.

Nickel Industry in 1955

Nickel production of the free world in 1955 again set a record with output estimated at about 427 million lb, states Dr. J. F. Thompson, chairman of the International Nickel Co. of Canada, Ltd., in a review of the nickel industry. This is an increase of approximately 40 million lb over the previous high level of 387 million lb in 1954, and 87 million lb over free world production in 1953. Total output by producers in Canada was expected to reach 347 million lb in 1955. This production is some 24 million lb higher than in 1954, and represents about 81 per cent of the free world production. Of the remaining free world production, Cuba accounted for approximately 7 per cent; New Caledonia, 5 per cent; Japan, 3 per cent; United States, 2 per cent; and various other countries 2 per cent. International Nickel's output of the metal in 1955 from its own ores reflected capacity production for the sixth consecutive year. The company's deliveries of about 285 million lb of nickel in all forms will be the highest in its history, representing approximately 65 per cent of the free world's supply.

The steel industries continued to constitute the largest markets for nickel.

Volume Binding Charges

Our Publishing Department informs us that owing to the increased charges now being made by the binders, the cost of binding a single volume of the *Electrical Review*, including the supply of binding case and index, will be 22s 6d, plus 1s 5d return postage. The cost of the binding case supplied separately will be 7s 6d, plus 6d postage.

Radio Trades Examination Board

On 31st December the Radio Trades Examination Board was registered as a company limited by guarantee, without share capital. The original number of members is 50, each being liable for £50 in the event of winding up. The word Limited is omitted from the title by licence of the Board of Trade. The objects of the Board are the promotion of a high standard of skill and efficiency in the technique and work of persons employed or otherwise engaged as radio mechanics and tradesmen in the radio and allied trades, etc. The management is vested in a Council, the first members of which include Mr. G. D. Clifford, and two others nominated by the British Institution of Radio Engineers, Mr. E. J. Emery, of E.M.I.

The stand of the Uganda Electricity Board at the agricultural and trade show in Kampala and (right) a cookery demonstration in progress

Sales, Ltd., and two others nominated by the Radio Industry Council, Mr. S. R. Burbidge, and two others nominated by the Radio and Television Retailers' Association (R.T.R.A.), Ltd., and Mr. R. Burnett, and one other nominated by the Scottish Radio Retailers' Association. The secretary is Mr. G. D. Clifford, and the registered office is at 9, Bedford Square, London, W.C.1.

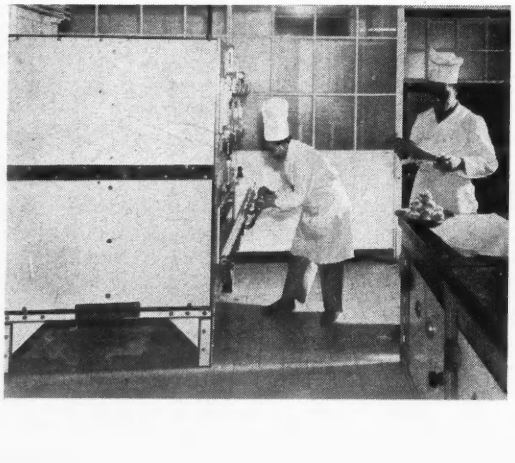
Electricity Supersedes Gas

In 1911 a school was formed near Hyde Park for a small colony of French children, sons and daughters of the French diplomatic corps in London. The accommodation originally consisted of a number of old houses, but in 1937 building commenced on the present premises of the Institut Francais du Royaume-Uni at South Kensington, opened by the French President in 1938; it is now the second largest day school in London with children of thirty-seven different nationalities attending. Feeding the children is a major operation. Over 7,000 luncheons a week are served as well as some 500 teas for the staff.

At first the school kitchen was provided with all gas apparatus but now it is gradually being refurnished with electric equipment. Latest stage in this conversion by the General Electric Co., Ltd., is the installation of a 14 kW double-deck pastry oven, finished in a light mottled-grey vitreous enamel with chromium fittings. Also installed in the kitchen are two G.E.C. double-oven ranges, a double-pan fish fryer, a 20 gallon boiling pan, a 16 gallon stock pot and a plain top hotcupboard used as a kitchen service counter. The senior staff servery is equipped with a 6ft plain top hotcupboard and two 2½ kW heating plates and the main dining room servery has a bain marie hotcupboard, comprising a bain marie and a 6ft plain top hotcupboard.

Specially made two-tier plate-warming cupboards have been installed in the main dining room. Other electrical equipment comprises a café set and a dish washing machine which includes a rinse-water calorifier. The total installed commercial catering load is now in the region of 235 kW. Throughout the Lycée G.E.C. switchgear and installation material has been used.

A G.E.C. double-deck pastry oven and one of the two G.E.C. double-oven ranges installed in the kitchen of the Lycée Francais



Expanded Metal Acquisition

The Expanded Metal Co., Ltd., has acquired the whole of the share capital of the Cressall Manufacturing Co., Ltd., Birmingham. The products of the Birmingham company are complementary to those of the electrical division of the Expanded Metal Co. at West Hartlepool, which makes electrical resistors and heaters. All shareholders in the Cressall Manufacturing Co. have subscribed for a substantial block of the ordinary shares of the Expanded Metal Co., Ltd., and Mr. H. H. Cressall (managing director) and Mr. R. Roberts (technical and works director) have entered into service agreements for a period of years so that continuity of management is assured.

Col. H. F. G. Langley, C.B.E. (director, Expanded Metal Co., Ltd.) and Mr. W. F. Knight (chief executive of the electrical division) have been elected to the board of the Cressall Manufacturing Co., Ltd.

Housecraft Advisers' Conference

Over 400 women representatives from Electricity Boards throughout the country will attend the annual four-day conference of Electrical Housecraft Advisers, which begins in London on 31st January. The conference, which is organized jointly by the Electrical Development Association and the Electrical Association for Women, will be held at Victoria Halls, Bloomsbury Square, W.C.1, and will be opened by Mr. D. Bellamy, vice-chairman of the Electrical Development Association and chairman of the Yorkshire Electricity Board.

Following the official opening, Miss F. F. Laidler, principal of the Battersea Training College of Domestic Science, will speak on "Home Economics, Present and Future." In the afternoon Mr. J. J. Devlin, principal bakery officer, British Baking Industries Research Association, will speak on "The Four Foundations of Good Baking."

On Wednesday, under the chairmanship of Commander Thompson, R.N. (Retd.), chairman of the South Eastern Consultative Council, Mr. J. A. Stedman, education officer (E.D.A.), will speak on "Salesmanship — Principles and Training Methods." In the afternoon Mrs. Marguerite Patten, B.B.C. television cookery expert, will give a talk on "Selling Electrical Appliances." A selection of the latest E.D.A. films will be shown.

On Thursday morning in the conference hall at Olympia, Mr. E. M. Ackery (E.D.A.) will speak about the E.D.A. stand at the Hotel and Catering Exhibition at Olympia, and will describe some of the exhibits to be seen at Olympia. On Friday morning a general discussion on the conference will take place at the Connaught Rooms, Kingsway, W.C.2, followed by the conference luncheon. In the evening (6 p.m.) the Caroline Haslett Trust Lecture will be given by Miss Mary Mitchell, of the London Electricity Board, at the Institution of Electrical Engineers.

Educational

A short residential course on the theory and uses of d.c. cross-field machinery has been arranged by the Regional Council for Further Education for the South West in collaboration with the University of Bristol and the Bristol Education Committee. It will be held at the University from 5th to 8th April next, and while it is primarily intended for application engineers and teachers of electrical machine principles, designers and specialists will be welcome. The fee for the course will be £2 2s plus a residential charge. Full particulars can be obtained from the secretary of the Regional Council, 12, Lower Castle Street, Bristol, to whom application forms should be returned before 31st January.

E.A.W. Gift to E.M.E.B.

Mrs. F. W. Godden, president of the Coventry and District Branch of the Electrical Association for Women, recently presented an electric clock to the East Midlands Electricity Board, as a token of appreciation of the services rendered to the Branch by the Board. This has been installed in the Board's new demonstration theatre in the Precinct, Coventry.

Calendar

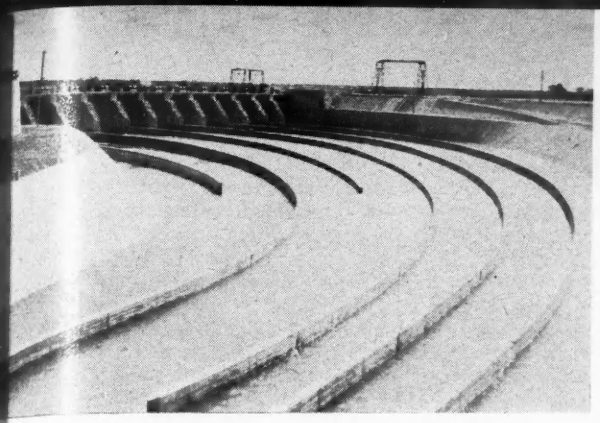
"Alarm in the Dunes," a picture of birds in flight, has been chosen for the tasteful calendar received from Fitter & Poulton, Ltd.

Trade Announcements

As from 17th January the new address of the Leeds district office of the **British Thomson-Houston Co., Ltd.,** will be St. Paul's House, St. Paul's Street, Leeds (telephone: Leeds 20718).

From 1st February the name of **Smiths English Clocks, Ltd.,** is being changed to Smiths Clocks & Watches, Ltd.

On and after 16th January the North-West England and North Midlands office of **Wild-Barfield Electric Furnaces, Ltd.,** will be at 1, Clarke-house Road, Sheffield (telephone: Sheffield 62784).



WORLD ELECTRICAL MARKETS

Prospects in Argentina

By E. M. WHITAKER, B.Sc., A.M.I.E.E.*

IT would be misleading to suggest that, at the present time, there exists a large market in Argentina for British electrical manufacturers as such a suggestion might give a false impression to potential exporters. It would be more accurate to say that there is to-day a very great shortage of electric power and of electrical equipment in Argentina, but, at the same time, that there is an equally great shortage of sterling which could be used for buying plant from Great Britain.

This sterling shortage has not only made import licences scarce but it has also made it necessary for the Argentine exchange authorities to insist upon some form of deferred payments for the greater portion of capital equipment imports for which exchange is granted. Such terms of payment are not always acceptable to British suppliers as they generally permit only a 20 per cent payment against documents, the remainder being spread over some five years from date of shipment. (Shipments of raw materials and spares for existing plant are being paid for by letter of credit.)

It is therefore more surely correct to say that a demand, rather than a market, exists but that it is difficult to satisfy this demand from the United Kingdom because of sterling shortages.

A picture of the possibilities in and needs of the Argentine Republic in respect of electrical development can be obtained very readily from a glance at the figures referring to generating capacity to-day and those estimating future requirements. The installed capacity of power stations supplying electric power as a public service is given in Table 1.

It is estimated that the additional installed capacity which will be required by the end of the next ten years is some 2,300,000 kW, which figure includes 1,300,000 kW for Greater Buenos Aires and 1,000,000 kW for the smaller towns in the country. (The estimates include renewals and replacements of existing plant.) It is further estimated that the cost per kW installed would be 3,000 pesos, thus making a total of about 7,000 million pesos, but it must be pointed out that this cost does not include any provision for distribution or for long-distance transmission.

For a true picture, there must be taken into consideration, in addition to the capital cost of these proposed installations, the expenditure on the greatly increased demand for fuel which the additional generating capacity referred to above would bring. The fuel consumption in recent years is shown in Table 2. Argentina imported some two-thirds of her fuel requirements in 1954 (see Table 3) and the present growth of her requirements is at the rate of about 612,000 tons (petroleum equivalent) per annum. The production increase within the country has been about 230,000 tons per annum which shows, there-

TABLE 1.—INSTALLED GENERATING PLANT IN ARGENTINA (kW)

Year	Greater Buenos Aires	Per cent	Rest of Country	Per cent	Total
1951	844,000	60	562,808	40	1,406,808
1952	876,500	60	578,488	40	1,454,988
1953	895,500	59	610,519	41	1,506,019

TABLE 2.—CONSUMPTION OF FUEL AND HYDRO-ELECTRIC POWER, 1950-54

(Thousands of tons, petroleum equivalent)

Year	Oil and Derivatives	Gas	Coal	Wood	Hydro Power	Totals
1950	8,478	457	1,250	2,847	43	13,075
1951	8,822	509	1,219	2,763	41	13,354
1952	9,077	551	1,240	2,953	57	13,879
1953	9,466	594	1,200	2,854	60	14,173
1954	10,020	625	1,200	2,860	80	14,785

TABLE 3.—SOURCES OF FUEL, 1950-54

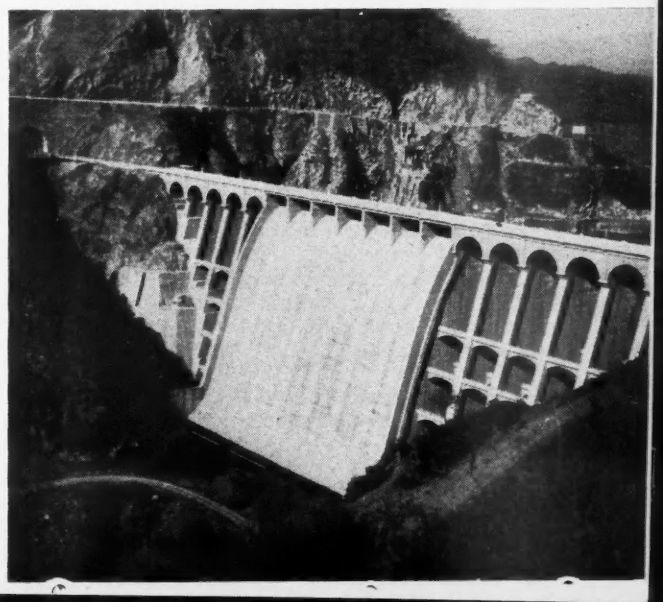
(Thousands of tons, petroleum equivalent)

	NATIONAL PRODUCTION				IMPORTS	
Year	Oil and Derivatives	Gas	Coal	Wood	Oil and Derivatives	Coal
1950	3,357	581	16	2,847	5,209	1,085
1951	3,501	639	24	2,763	5,677	1,626
1952	3,552	691	67	2,953	6,225	1,305
1953	4,079	717	49	2,854	5,980	888
1954	4,229	758	65	2,860	6,109	1,130

Top: Forty-one electrically-operated sluices control the flow from the Quiroga dam (Santiago del Estero). There is a small hydro-electric station (2,000 kW) the surplus power from which is supplied to Santiago

Right: The Escaba dam on the Marapa River, Tucuman Province. It has a storage capacity of 126 cu hectometres and the associated generating plant develops 10,000 kW

* British Thomson-Houston Co., Ltd., Buenos Aires.



fore, an ever-increasing gap which has to be filled by additional imports unless means are found to increase national production.

There has been a small increase in the consumption of power per head of population which itself has increased over the past years. It is inferred from graphs published by the Confederación General Económica that the power consumption (fuel equivalent) was about 0·675 ton in the period 1935-39 and rose to 0·715 ton during 1940-44. It rose again during the period 1949-54 to about 0·775 ton. In the thirty years covered by the graphs the power consumption per inhabitant rose by 16·5 per cent.

The figures quoted demonstrate that a very great demand exists for generating plant and distribution equipment. Increasing industrialization also brings a demand for industrial electrical equipment of many types, including diesel-electric generating sets, which have to be largely used to offset the shortage of power from public service stations. Generating plant and high-voltage distribution equipment are not commonly built in the country and, provided exchange is available, permission is often given to import. The position is a little different as regards lower voltage distribution equipment, distribution transformers and industrial motors as these are largely made by a growing national industry which is protected by an almost total prohibition of imports, the necessary raw materials only being imported from various sources.

The demand for consumer goods is entirely satisfied by national production which makes refrigerators, automatic washing machines, fans, electric irons and a host of other devices to modern designs of pleasing appearance. Local manufacture uses mainly original designs, but, in some cases, builds under licence from foreign firms of international repute. With the present shortage of foreign exchange, however, it is difficult, if not altogether impossible, to obtain permission for the remittance of royalties unless the foreign firm is prepared to invest capital under a recent law governing the entry of foreign capital.

Argentina can be classified to-day as a country which could be a good customer of Great Britain for capital plant and equipment were her exchange problems solved. These present problems limit her possible trade with Great Britain at the moment to the barest essentials, but such difficulties will not continue indefinitely and a time can be foreseen in the not too distant future when the flow of capital goods from Britain will increase, giving British engineering knowledge and skill a share in the rapidly developing Argentine Republic.

Footnote.—Recent Government changes in Argentina have brought with them changes in economic policy. It would appear that a more orthodox financial policy is to be adopted in the future, especially as multiple rates of exchange have been abolished. Remittances for financial services of various types are being permitted and there is also some indication that the Government realizes the inadvisability of short-term credits for capital goods. The general situation is, however, not yet settled.

More recent events indicate that, to help to overcome the serious power shortage, permission is being given for the importation of generating sets by industrialists for their own immediate use, thus giving some relief to the overloaded public supply systems.

C.I.G.R.E. 1956 Programme

PRELIMINARY particulars of the sixteenth biennial session of the International Conference on Large Electric Systems (C.I.G.R.E.), to be held in Paris from 30th May to 9th June next, are given in its Bulletin No. 1, now available. Dr. R. A. Schmidt (Lausanne) is president and Mr. J. Tribot Laspiere vice-president and delegate-general. There are thirty-three national committees, that for Great Britain having Mr. P. V. Hunter as chairman and Mr. R. A. McMahon (Thorncroft Manor, Dorking Road, Leatherhead, Surrey) as secretary.

The provisional list of papers, including reports of international study committees, number 118. Fourteen will be presented by authors from the United Kingdom, two from Australia, four from Canada, one from Ireland and one from South Africa on the following subjects:—Diagnosis of steam-alternator performance by stroboscopic methods (E. B. Powell); digital electronic deceleration measurements in tests on water-wheel generators (D. T. Bath); temperature rises in alternators (E. W. Connon and S. J. Morley); transformers (E. T. Norris); transformer noises (G. B. Harper, S. Glover and C. M. Brownsey and E. Tobin); testing on-load tap-changers (E. C. Rippon); chopped-wave impulse testing (L. L. Preston); a new Canadian circuit-breaker (J. P. Skillen and D. H. McKeough); compression cables (C. T. W. Sutton and A. M. Morgan); all-aluminium 300 kV cable (H. D. Short); mechanical design of transmission lines (H. C. Harrison and E. W. F. Bowling); Canadian overhead lines (U. F. Crowley); insulators (G. H. Gillam); control and intertripping on the British grid (W. Casson and P. F. Gunning); Petersen coils on Eire 110 kV system (W. P. Leech and S. Tinney); mounting protective relays (A. R. Van C. Warrington); e.h.v. transmission in Australia (W. Diesendorf); measuring excitation and load-angle characteristics of alternators (S. V. Byrne and D. Carrol); series capacitors for voltage regulation (L. H. Black); comparison of costs of high-voltage d.c. and a.c. transmission (F. J. Lane); telephone and radio interference (L. Gosland).

News from South Africa

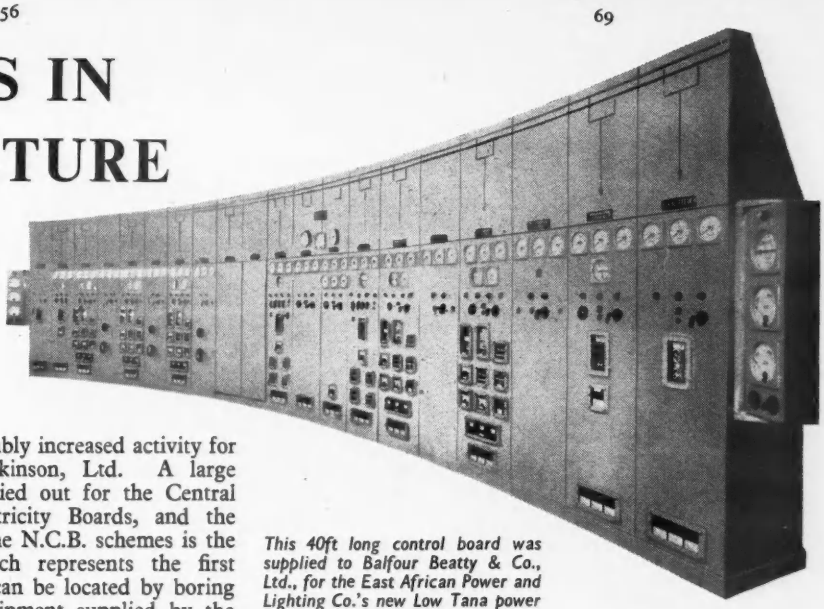
For the control of all incoming and outgoing electrical circuits of the new Orange Free State water supply scheme a ten-panel vertical isolation, horizontal draw-out, duplicate busbar, metalclad switchboard is being supplied by Ferguson, Pailin, Ltd. The switch units controlling the motor circuits will be operated from a central control panel.

Contactor (Pty.), Ltd., Zuider Paarl, near Cape Town, which is associated with the Rheostatic Co., of Slough, England, is making the Satchwell type of temperature control switches. In addition to the hotplate controls of the "HS" type at present in production at Paarl the new "SA" type of switch has now been introduced. It is claimed that this has all the virtues of the older pattern as well as many new features.

During the past financial year £17,000 has been spent on new plant and equipment at the Eveready factory in Port Elizabeth. This additional plant has enabled the company to meet the increased demand for its products and it is planned to place further orders for modern plant and equipment to the value of some £40,000 for installation next year. This will result in the appearance of new and improved types of battery.

PROGRESS IN MANUFACTURE

Crompton Parkinson Activities in 1955



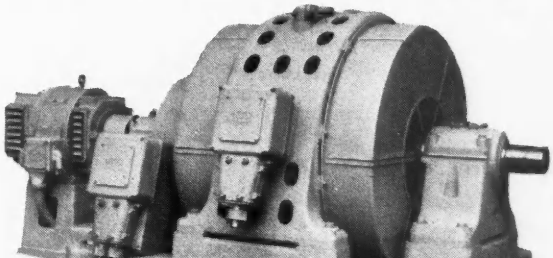
This 40ft long control board was supplied to Balfour Beatty & Co., Ltd., for the East African Power and Lighting Co.'s new Low Tana power station near Nairobi

LAST year was one of appreciably increased activity for all divisions of Crompton Parkinson, Ltd. A large volume of work was again carried out for the Central Electricity Authority, the Electricity Boards, and the National Coal Board. One of the N.C.B. schemes is the sea drilling tower project which represents the first attempt ever to prove that coal can be located by boring through the sea bed. The equipment supplied by the company included the generators and switchboard for the main power supplies, motors for the hoists and distillation plant, and the generators for lighting and auxiliary power supplies.

One of the most impressive contracts completed by the company last year was that for the electrification of the new sulphuric acid/cement plant of Solway Chemicals, Ltd. For this project, C.P. laid an 11 kV ring main, erected and completely equipped five substations, and installed upwards of 430 motors ranging from fractional h.p. sizes to 850 h.p. A centralized control system and all lighting equipment for the project were also supplied. The motor car, cement and oil industries placed particularly heavy orders, but the general demand for the company's services and products was widespread, coming from practically every branch of Britain's industry.

Overseas, the £750,000 long-term contract with the Government of Malta for renewing and extending virtually the complete power cable distribution system on the island, together with the supply of ancillary equipment, was brought nearer completion. In the Far East, the Crompton Engineering Co. (Madras), Ltd., secured a contract valued at £750,000 in connection with a high-voltage overhead line distribution scheme for Burma, while from the U.S.S.R. there were several orders for cable, transformers and switchgear.

Among many other overseas contracts reference should also be made to one which was completed last year for the Tasman Pulp & Paper Co., Ltd., who are operating a new timber and paper pulp project in the Kaingaroa State Forest, New Zealand. This £186,000 contract was for the supply of all 11 kV switchgear (forty 500 MVA units), and also for the supply of six exciter control panels, about 1,000 squirrel-cage motors ranging in size up to 200 h.p. and twelve motor-generator sets.



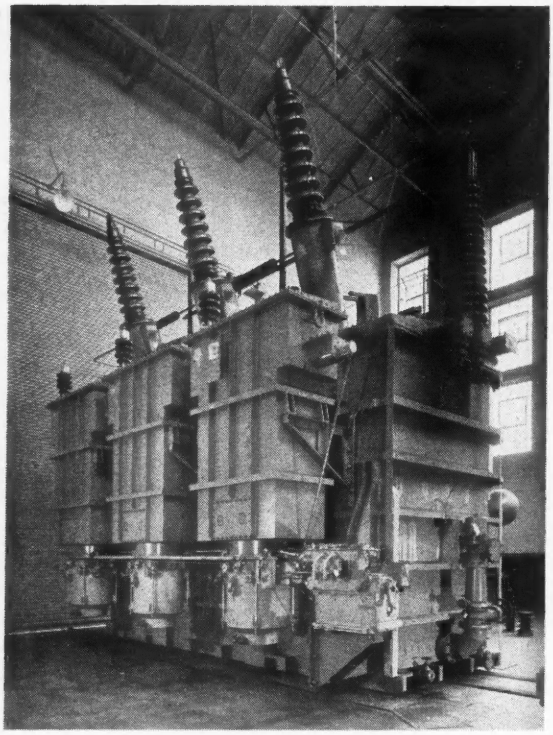
The second of two 1,500 h.p. auto-synchronous motors supplied by Crompton Parkinson for driving cement grinding mills in a new extension at the works of Shred Digvijay Cement Co., Ltd., India

Reviewing the progress made in each of the main product divisions separately, 1955 was a particularly successful year for rotating plant. Of more than usual interest were two special purpose motor-alternator sets supplied to the Admiralty. These alternators, of 20 and 40 kVA respectively, were both provided with voltage control to within ±0·25 per cent of nominal; the larger set, moreover, was fitted with an electronic controller to limit frequency variations to well within ±0·15 per cent. Also of interest was an order received from a non-ferrous metal extruding concern in Birmingham, for twelve 130 h.p. auto-synchronous motors and a 65 h.p. motor. These machines were required for the hydraulic pumps of what is believed to be the largest extrusion press in the world. A 13-panel substation switchboard was also supplied under the order.

Overseas business included a dollar order from the India Supply Mission in Washington for nineteen 25 h.p. auto-synchronous motors which are to be supplied to the Indian Government; another dollar order calling for 396 special generator sets for ground power units which are to be used for servicing and starting jet aircraft of N.A.T.O. air forces; and an order for 250 3 h.p., 1,720 r.p.m. motors for operation in ambient temperatures of 170 deg F in the Canadian Kitimat project.

Last year saw the virtual completion of a major reorganization scheme at the company's B.E.T. works at Hayes, Middlesex, which has been conducted over a period of about ten years and enables the company to construct and test any transformer that is likely to be required in the foreseeable future. One of the largest transformers to leave the works to date is the 120 MVA, 275 kV/132 kV transformer which was installed on the C.E.A. supergrid at Elstree. This is being followed by three similar units from Hayes, and orders are also in hand for two 120 MVA, 66 kV/275 kV auto-transformers for the supergrid at Iver.

At the other end of the scale, there was a good demand at home for the pentagon-shaped rural transformers which were introduced late in 1954. These transformers,



A 120 MVA supergrid auto-transformer weighing 250 tons installed at Elstree

notable for their low iron loss characteristics and high overload capacities suitable for low load factor circuits, were made available in 5, 10 and 15 kVA sizes for 6·6 and 11 kV service. To meet demand, the range was extended last year to cover 20 kV service.

The demands of both supply authorities and industrial undertakings in the United Kingdom ensured a steady flow of work for the Chelmsford switchgear works. Export orders also continued at a satisfactory level, a notable feature being a considerable increase in sales to the North American market. In some respects, the most impressive single order of the year was that for a 14-panel, double-busbar, 11 kV, 350 MVA, switchboard and a 40ft long control board; this equipment was supplied for the new Low Tana power station near Nairobi. The year was also marked by the introduction of outdoor units for service voltages up to 11 kV. These completely weatherproof units were designed to incorporate ALA and CLA circuit-breakers and ASA and CSA isolating switches.

Partly as a result of numerous large orders received from abroad and an increased number of contracts with the G.P.O., the N.C.B. and the electricity supply industry, business for all departments in the cable works at Derby showed a considerable improvement on the previous year.

In Canada, the decision to increase the number of cars on the Toronto Rapid Transit underground system resulted in an order for a further thirty-four sets of electric traction equipment. These sets are similar to the C.P. equipments supplied in 1953 for the first 104 cars. For fourteen 955 h.p. diesel-electric locomotives now in service on the Commonwealth Railways of Australia, the order was completed for the electrical power equipments, and similar sets were supplied to the Sierra Leone Development Corporation for five diesel-electric locomotives of 1,000 h.p. Among other overseas orders may be mentioned one for thirteen sets of electrical equipment for diesel-electric locomotives for the Gold Coast Railways, and another for traction motors for trolley locomotives which will be employed in the South African goldfields.

At home, for British Railways, the company delivered ten complete power equipments for 350 h.p. standard diesel-electric shunters, and as part of the extensive contracts announced by the British Transport Commission in November, the company is to supply complete electric traction equipment for thirty main line locomotives.

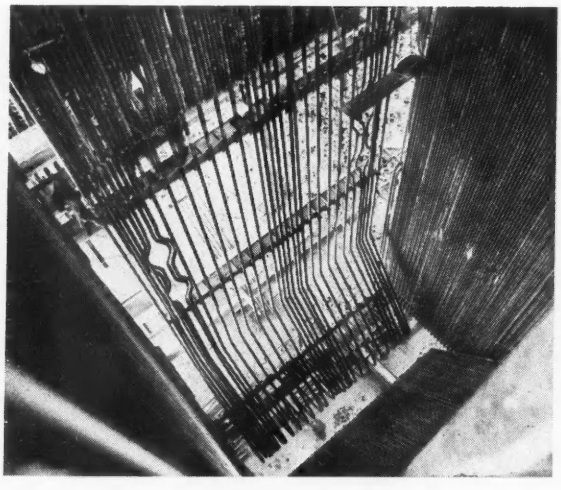
A heavy demand for such instrument developments as the circular scale, the recently marketed shockproof designs and hermetically-sealed designs, kept the Instrument Department busy, while good progress was also made with respect to lighting fittings, lamps, batteries and stud welding.

CLARKE, CHAPMAN & CO., LTD.

FIVE boilers designed and manufactured by Clarke, Chapman & Co., Ltd., of Victoria Works, Gateshead, have been commissioned and put on load at Stella North and Stella South generating stations, near Blaydon, Co. Durham, during the past year. The first began operating on 20th December, 1954, and on 15th December, 1955, almost exactly a year to the day, the fifth went on load well inside the schedule set for the company. The main contractors for boiler plant at the Stella stations, Clarke, Chapman & Co., Ltd., have four more boilers to complete and these will be operating by December this year.

The boilers at Stella are the radiant heat type, each comprising a fully water-cooled combustion chamber with controlled type superheater, and an economizer. Each boiler is fed by four Raymond bowl mills which supply them with pulverized fuel. Auxiliary equipment includes air heaters, electrostatic precipitators and mechanical draught plant. Each boiler has an evaporative capacity of 550,000 lb/hr at 950 lb/sq in and 925 deg F.

In addition to the Stella installations the company is at present engaged on such contracts as the Brunswick Wharf, Poplar, generating station and the Goldington generating station, Bedford. Clarke, Chapman boilers are also being installed in paper mills, collieries, steelworks and other industrial plant.



Furnace wall tube erection in progress at Stella South generating station

Electricity in Tobacco Growing

Irrigation Methods in Southern Rhodesia

By J. G. NEVILLE*

SINCE 1946, rural electrification in Southern Rhodesia has advanced rapidly, particularly in the tobacco growing areas in the north and east of the Colony. At the same time, the production of Virginia tobacco has increased; all records were broken at the end of the 1954-55 season with a total crop of 121 million lb selling for over £20 million sterling.

It is interesting to note the effect that the irrigation of this crop is having on electricity consumption and, if present experiments and research continue to produce the satisfactory results so far achieved, electricity consumption on the tobacco farm will increase at a phenomenal rate.

Tobacco does not require continuous moisture and, in fact, grows better when subjected to periods with no rainfall whatsoever. It is, however, dependent entirely upon the whim of the weather and even in a country with clearly defined wet and dry seasons, there is no guarantee that rain will fall just when required and in the right quantities for the best growth.

In the past nine years experience has proved to tobacco growers that several advantages are gained from early planting, such as increased yield per acre, greater freedom from disease and pests, and a reduction in the fertilizer bill. This early planting, however, means that it is being carried out before the rains are in any way settled and thus the need for irrigation is growing. Since information and experience is still being obtained each year, the present

AVERAGE MONTHLY CONSUMPTION OF ALL FARMS SERVED BY THE ELECTRICITY SUPPLY COMMISSION

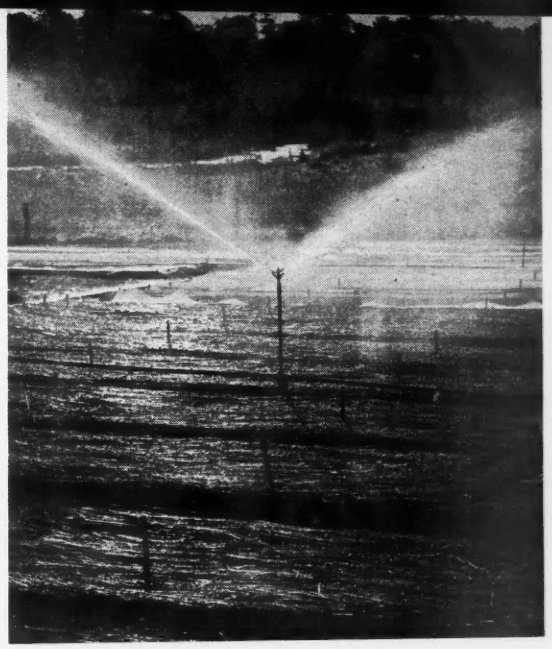
Year	September	October	November
	kWh	kWh	kWh
1949	681	655	641
1950	714	680	691
1951	707	760	590
1952	802	783	748
1953	906	974	984
1954	1,099	1,120	1,130
1955	1,216	1,291	1,322

trend is for the established grower to try out an experimental section and add to his previous knowledge experience from practical application.

From the electricity supply point of view several advantages are noticeable. Firstly, there is an increased consumption; secondly, there is the need for additional points of supply, thus improving the density of consumers per mile of line; and, thirdly, this type of irrigation comes during the summer period of lighter loads.

The main irrigation months for this crop are September, October and November, and the table shows how the average consumption for these months has grown. The improvement in annual station load factor is obtained through the main station peak occurring in the months of

* Sales Development Engineer, Electricity Supply Commission, Southern Rhodesia.



Tobacco plant seedlings being sprayed before being transplanted

June, July or August. During these months there is no need for tobacco irrigation other than for early seed beds which requires little more than 2 to 5 h.p.

Other types of load tend to fall off after August and by the time the irrigation load reaches its peak, in October or November, there is a drop in load which is gradually being picked up by the pumping load. Individual installations vary considerably, from the consumer trying out an initial installation for 5 acres with a 10 h.p. pump, to the larger grower who has developed to the extent of a 75 h.p. unit.

The system of using several small sprays on a light alloy pipe-line which is moved from section to section is the most popular and has completely superseded the large high-pressure, large output rotating spray. Because of possible interference from wind, many installations only operate at night when evaporation is also lower. This again is all to the suppliers' advantage.

In the 1953-54 season one typical consumer decided upon a pilot scheme which embodied 10 acres under sprays. On this farm there was an irrigation furrow running through the lands, and sumps were constructed every 90 yd. A 380 V three-phase line was run alongside this furrow with plug points at strategic positions to enable a portable motor of 6 h.p. driving a 1½in centrifugal pump to be connected where required. The 3in aluminium piping with twelve sprays was able to apply approximately 80 gal/min.

The pumping installation was capable of effectively watering 2½ acres in 24 hours. The crop was watered continuously for six weeks, then for ten hours a day; intermittent showers appeared and then irrigation was not used after ½in of rain had fallen.

The results achieved, of over 1,700 lb per acre of good quality tobacco, were so satisfactory that in the 1954-55 season a further 30 h.p. installation was completed and for the present season another 30 h.p. unit has been installed, pumping from a recently constructed farm dam of 10 million gal capacity. Work is also in hand for a separate supply point to open up another section of land with a further 30 h.p. pump unit.

This consumer's consumption rose from 2,048 kWh for the year ended March, 1952, to 12,860 kWh for 1953-54, and 40,608 kWh for 1954-55; up to November, 1955 (eight months) the consumption had reached 32,735 kWh.

Highland Water Power

I.E.E. DISCUSSION

AT a meeting of the Institution of Electrical Engineers on 5th January a paper by the late T. Lawrie on the developments of the North of Scotland Hydro-Electric Board (reported in the *Electrical Review* of 6th January) was presented by Mr. A. A. Fulton, who said that the cost of providing a connection in 1954 to a rural consumer amounted to £184. The payments made by these rural consumers for their electricity did not cover the cost of supplying them.

Sir Charles Westlake described Mr. Lawrie as much more than an electrical engineer and as one who, believing in electricity as a great social service, was determined to see its benefits taken to the remote areas.

Mr. T. G. N. Haldane (Merz & McLellan) referred to the benefit of the Board's work in facilitating the work of British firms abroad. Maximum economic advantage would apparently be achieved by developing hydro-electric power at a low load factor. It would become increasingly necessary to integrate hydro and thermal power partly through pumped storage, especially if the pumped storage plant were superimposed on existing or contemplated hydro schemes.

Mr. J. D. Peattie (C.E.A.) suggested that both hydro and thermal engineers could well reconsider the question of load factor. Nowadays, the amount of coal available at a given site was restricted just as the energy available from the catchment area was restricted by the amount of water which came down. The amount of energy allocated to a site was first fixed and the amount of kW capacity to be provided on the site was fixed afterwards; the total capacity had to be equal to the total load as a minimum. It had been accepted that it should not be more than that minimum but it was doubtful whether that was the exact solution to the problem.

Lord Hurcomb said naturalists throughout the world had become increasingly disturbed at the immense destruction of areas and life of great biological interest through interference with the regime of rivers, and the International Union for the Protection of Nature had devoted a great deal of time to the problem. Until recently the engineer had not been sensitive to the biological consequences of his work while some naturalists had made insufficient allowance for economic necessities. The Union took the view that many biological losses during the construction of hydro-electric schemes could be avoided by consultation at the beginning between engineers and biologists. The North of Scotland Board had been advised by a distinguished biologist—an example to other authorities.

Replying to Mr. R. W. Mountain (Kennedy & Donkin) in regard to the consequences of the drought in Scotland last year, Mr. Fulton said the run-off was 72 per cent of average, 17 per cent of which was contributed in December.

Mr. M. Braikevitch (English Electric Co.) showed slides of pumped storage plant and said that intensive research was being carried out for combining the turbine and pump in one machine.

Mr. J. Guthrie Brown (Sir Alexander Gibb & Partners) described power stations which he had seen on a tour of Australia, Tasmania and New Zealand and complimented the North of Scotland Board on its high standard of design and execution, which, he said, could stand comparison with those in most countries.

A view of the Lawers Dam in the Breadalbane district under construction

Mr. J. M. Ferguson (English Electric Co.) emphasized that the co-operation of the Board had been of great benefit to British manufacturers, for the experience had helped them in other parts of the world. He wondered whether the difficulty of getting skilled staff for remote stations would lead to more automatic control and whether the Board had considered the use of high frequency in their hay-drying operations.

Mr. C. M. Roberts (Sir William Halcrow & Partners) suggested that while the Borland fish pass might be satisfactory for low and medium head stations, when there were several hundred feet in the reservoir, but a mechanical fish lift might be more practical for larger dams.

Mr. J. C. Beverley (English Electric Co.) described a number of overseas developments which had arisen from work in Scotland. Although schemes in Scotland were of smaller installed capacity than those in other countries, the experience gained had been of great value. For instance, the Snowy Mountains Authority took two machines of the Sloy type for their first scheme. In Canada, in a scheme with a head the same as at Sloy, the output of turbines designed in this country had been raised to 175,000 horsepower.

Replying to Mr. A. R. Cooper (C.E.A.), who had suggested the use of pulverized-fuel fly ash instead of blast-furnace slag in dam construction, Mr. Fulton said it did not provide the same cement replacement and was not regular in quality. Mr. Fulton added that the increased capital cost would make it difficult for crofters to obtain equipment for high-frequency hay drying.

An Electricity Board's Work

Mr. E. Sinnott, chief accountant of the South Eastern Electricity Board, gave a talk on the work of his Board at a meeting of the British Institute of Management on 5th January. He outlined the Board's structure, mentioning the devolution of authority to the sub-areas and districts. Naturally he dealt mainly with the accountancy system and described how it was operated in the various formations.

His purpose was to demonstrate that the Electricity Boards were alive to their public responsibilities and that those on the accounting side were doing their best to contribute to efficiency by matching the best commercial practice.

VIEWS on the NEWS

By REFLECTOR

MR. R. A. MARRYAT'S New Year presidential message to members of the Electrical Contractors' Association in the January issue of the *Electrical Contractor and Retailer* urges them to give more to the industry than they take out. He also stresses the need for gaining the enthusiastic support of employees in giving customers better service at no greater cost. This is unexceptionable but I am not with him when he goes on to say:—

> "We must seek to strengthen management and to increase the financial resources that we have available to meet the needs of future development. We must plough back more profit into our business, and indeed make larger profits, if we are to broaden the scope of our activities in line with the expected requirements for new domestic, commercial, industrial and rural applications of electricity. After all, the Treasury is the largest shareholder in each of our concerns; by making larger profits we help to keep it solvent and also insure our ability to provide continuity of employment in the future."

Larger contributions to the Exchequer may keep the Treasury solvent but what is the effect upon the nation's economy? Already the Chancellor is getting too much out of industry with the result that the cost of living continues to rise and consequent wage demands add to the snowball. Our aim should be to see that the Treasury ceases to be the "largest shareholder" as soon as possible.

* * *

I made reference two or three weeks ago to the models of electrical appliances which are now available to children. In Russia electrical toys seem to be more ambitious. A special correspondent writing in the *Financial Times* says:—

> "There is a Toy Research Institute in the U.S.S.R., which in line with the great electrification scheme of the country has developed little hydro-turbines that work, and with an eye to the developing mechanization of agriculture, model harvesters and tractors with three attachments."

* * *

A domestic consumer on the mains of the London Electricity Board tells me that he recently wanted a fire installed in his bathroom. He obtained the fire, a 1 kW wall-mounting type operated by a cord switch, and asked the Board to fix it. The quotation received from the Board was for a run from the supply point on the floor below—a few yards of 3/·036 t.r.s. cable, a 15 A switch-fuse and a 5 A ceiling cord switch, and the amount was put at £8 5s. One clause was: "Earth and bond fire as necessary." In due course the work was done and a little later the Board sent round one of its inspectors who was apparently satisfied and the circuit was connected. Over a month after this a registered letter was received from the Board's district manager saying that "certain defects were noticed in the installation"; these were specified as follows:—"Bathroom.—Fire should be earthed and also bonded to other metal work in the room. Flexible cord to fire should be renewed." The letter pointed out that "the Board is not responsible for the safety of your installation or for any expenses incurred in the matter." Copies of the Electricity Supply Regulations were enclosed and the consumer was further informed that: "The work may be done by an electrical contractor or, if you so desire, the Board will submit a quotation and carry out the work upon receipt of your instructions. A postcript gave the warning:—"This matter is particularly urgent as the apparatus is at present *potentially dangerous.*"

The consumer, who is normally well disposed towards the Electricity Board, wants to know whether there have been many other instances of this kind of thing. I think that it may demonstrate the complete impartiality of the inspection department and its total independence of the installation department. It will even condemn the Board's own work if necessary.

* * *

Mr. Alex. Davidson, of Carntyne, Glasgow, has sent me a leaflet, printed in the forties of last century, advertising an "Electro-Magnetic Exhibition" at the Egyptian Hall, Piccadilly, under the patronage of the Royal Scottish Society of Arts. Several items were displayed "showing the application of this new power to machinery of various kinds; and of apparatus exemplifying, on a large scale, the effects of the Electro-Magnetic Fluid as a Chemical Agent." These devices had been contrived by Mr. Davidson's great-grandfather, Mr. Robert Davidson, of Aberdeen, who claimed to be "the Inventor and Constructor of the first Electro-Magnetic Locomotive (which was recently tried on the Edinburgh and Glasgow Railway)." The exhibits included a locomotive engine, a turning lathe, a saw mill, "a machine for communicating the electro-magnetic shock" and a printing machine. (The leaflet, by the way, appears to have been printed by the last-named—not with overwhelmingly successful results.) Mr. Davidson is anxious to discover further information about his great-grandfather who lived from 1804-1894. Perhaps some of my readers could help him.

* * *

Recent railway accidents have shown the desirability of coaches of steel construction and some newspapers have made it appear as though such coaches are comparatively modern. Yet fifty years ago the *Electrical Review* (12th January, 1906) described steel cars built by the Brush Electrical Engineering Co. for the London Underground Railways, the L.C.C. Tramways and the electrified section of the London, Brighton & South Coast Railway. It was stated that:—

> "The Great Northern & City cars may be taken as typical of steel construction at the present time; steel under-frames, corner posts, intermediate pillars, car lines and outside panels, together with a sheet-steel floor covered with a non-inflammable layer of lito-silo, are among the prominent features."

It was explained that "lito-silo" was a composition of whiting, cork dust, iron oxide and cement resembling linoleum in its resiliency but unaffected by heat or cold.

Electrical Currents in the Ionosphere

ON the occasion recently of the opening of the new premises of the Tait Institute of Mathematical Physics at the University of Edinburgh, Sir Edward V. Appleton, G.B.E., K.C.B., F.R.S., Principal of the University, delivered a lecture on the above subject in which he gave an account of some researches on the ionosphere which he had recently completed with the help of Mrs. A. G. Turnbull and Mr. A. J. Lyon, of Edinburgh University. The new studies provided some direct evidence of the existence of large-scale electrical currents in the upper atmosphere. The work had involved the construction of a world-picture of upper-atmospheric electricity and a study of the movements of that electricity. This world-picture had been derived by collating experimental results which had been sent to Edinburgh University by ionospheric stations throughout the world. No measurements of upper-atmospheric electricity had actually been made in Edinburgh, and the new results had been obtained entirely by way of the friendly supply of data by other people. The work was a typical instance of international collaboration.

Sir Edward said that, for many years, we had known that the earth's magnetic field underwent small, but detectable, rhythmic changes every day. An Edinburgh graduate, Balfour Stewart, had boldly suggested as far back as 1882 that these magnetic changes were probably due to electrical currents circulating in the upper atmosphere. Since that time evidence had steadily accumulated in favour of this hypothesis. That the upper atmosphere was in fact an electrical conductor was proved when the ionosphere was discovered in 1924. But, until recently, it was not known at which atmospheric level in the ionosphere the hypothetical currents were flowing.

The new Edinburgh researches began with the discovery that one of the layers in the ionosphere—the Heaviside Layer—was seriously distorted in structure. Its formation did not conform with theory. Further theoretical work was necessary to predict the type of deformation which a circulating system of electrical currents would produce in an ionized layer, and it was found that the type of deformation predicted was precisely that which had been identified in the Heaviside Layer. It could therefore be concluded that the Balfour Stewart theory was correct, and that the electric current circuit envisaged was situated at a level of about 60 to 70 miles above the ground. Sir Edward added that a more comprehensive volume of data in which the Edinburgh conclusions could further be checked would be available after the International Geophysical Year of 1957-58.

Snowy Scheme Amended

THE Minister for National Development, Senator W. H. Spooner, has announced major changes in the Snowy Mountains hydro-electric scheme which, while reducing the cost possibly by about £23 million, will provide extra water for irrigation and substantially increase the amount of power generated in the near future from the Snowy River.

Under the revised plans, which have now been authorized by the Federal Cabinet, part of the scheme which was to have cost £27 million will be eliminated and replaced by another project to cost £4 million. The original proposal, Senator Spooner explained, provided for the upper Murrumbidgee River to be diverted through an eight-mile tunnel into the Yarrangobilly River, a tributary of the Tumut. This water was to have been diverted and regulated by a dam about 11 miles north-east of Kiandra, known at Tantangara. It is now intended, he said, to divert the upper Murrumbidgee River to Adaminaby reservoir, on the Eucumbene River, instead of to power stations T3 and T4 on the Yarrangobilly River. The diverted Murrumbidgee water, together with the waters of the Eucumbene River and the diverted Tumut and Tooma Rivers, would be stored and regulated in Adaminaby reservoir. Senator Spooner said this water then would pass through the Eucumbene-Tumut tunnel to the upper Tumut River and to power stations T1 and T2. It would then return down the Tumut River to the Murrumbidgee River for irrigation.

The change of plan would increase the annual energy production of power stations T1 and T2 from 1,226 million to 1,666 million kWh, an increase of 36 per cent. Station T1 should begin production in 1958 and T2 in 1962. This power would be cheaper than that which it was already planned to produce from stations T1 and T2 and that which might be obtained from stations T3 and T4 in the future. This was because the cost of the Murrumbidgee-Adaminaby tunnel, the only additional work, was small compared with the additional water which now would flow through stations T1 and T2. The estimated additional power from this water would be about 75 per cent cheaper than the present estimates. The dam at Tantangara had always been part of the irrigation proposals under the scheme. Under the revised plans it would be built within the next few years instead of perhaps 20 or 30 years.

Senator Spooner said that it was not easy to say what would be the ultimate effect of the alterations on the scheme. The elimination of stations T3 and T4 would normally reduce the total generating capacity by 300,000 kW, but about the same amount of generating capacity could be added to other stations. "The final answer will only be determined as the years go on," he said. "It may be decided to reinstate stations T3 and T4 in the scheme, or events may show that some generating capacity can be obtained as economically or more economically elsewhere."

The net reduction of £23 million in the cost of the scheme was based on a "suppositional approach" and oversimplified the calculation. The final cost would be determined in the future as the demand for power increased; this demand would undoubtedly necessitate the use of all generating opportunities to meet the requirements of New South Wales and Victoria on the most economic basis.

Large Computer in America

A GIANT computer which is believed to be the first of a new high-speed type for education and basic research is to be installed at Massachusetts Institute of Technology. It will be made available by International Business Machines Corporation and will be the principal tool in a new electronic data processing centre, and other colleges and universities in the U.S.A. have been invited to share in the use of the machine for research and education of students in computing techniques. The computer will be installed in early 1957 in the Karl Taylor Compton Memorial Laboratories which the M.I.T. is now building in Cambridge at a cost of $4,000,000. Dr. Philip M. Morse, Professor of Physics, will be director of the computation centre.

The computer will be an electronic data processing machine designed for solving mathematical problems in engineering, science, social science and management studies. Its speed of operation will be so great that in one second it will perform 40,000 additions or subtractions or 5,000 multiplications or divisions of ten-digit numbers. It will have a magnetic core "memory," a device in which information is stored on thousands of tiny magnetized beads. This new form of "memory" was developed by M.I.T. scientists in collaboration with the I.B.M. staff.

Electricity in Mines

PRINCIPAL ELECTRICAL INSPECTOR'S REPORT FOR 1954

THE following are extracts from some of the more interesting items in the report of the Principal Electrical Inspector of Mines (Mr. J. Cowan) for 1954 (H.M. Stationery Office, 2s.).

On 1st September, the Coal Mines (Mechanics and Electricians) General Regulations, 1954, came into operation and General Regulations 131 (*a*), (*b*), (*c*), (*d*), (*e*), (*h*) and (*i*) under the Coal Mines Act, 1911, were revoked. The 1954 Regulations require, among other things, that the electrical engineer or electrician-in-charge of electrical plant shall ensure that the electricians of the mine supervise or effect the installation, examination, testing and maintenance of all electrical plant at the mine. The manager is required to ensure that there is a scheme in force to cover the systematic examination and testing of all electrical plant and to ensure its proper maintenance. The scheme must specify the intervals within which all the electrical plant must be examined and tested and the nature of the examination and testing to be carried out on each occasion.

The National Coal Board has sent out to managements a specimen scheme as a guide to colliery staffs, and it has been adopted as a basic scheme in a number of areas though generally with some modifications. Reports from electrical inspectors, however, show that by the end of the year, because of shortage of staff at many collieries, the intervals shown in the specimen scheme cannot be adopted. Managers are in some cases proposing individual schemes which they consider can be worked by the staff they have available. Shortage of electrical staff at some collieries is nothing new and electrical inspectors have on many occasions raised this matter with managements concerned.

Damage to Trailing Cables

The reports of electrical inspectors stationed in the various divisions show that during their inspections they too often find trailing cables lying on the floor of the coal face and sometimes covered by debris; abuse of and damage to hand-held drilling machines on the coal face; set screws missing from the covers of the flameproof apparatus; and lack of adequate identification labels on switchgear and cables. Inspectors also report that they find considerable overloading of machines, especially conveyors, and they have drawn the attention of managements to this bad practice. The frequent damage to trailing cables used with certain types of power loader installations is also disturbing. It was reported that in some cases cables have to be sent out of the pit for repairs at least once a week. In general, it appears that such cables are seldom in use, between repairs, for periods exceeding three weeks.

At a number of mines where automatically-controlled winders were used for coal winding, the shaft gates and signalling systems were so interlocked that all gates had to be closed before signals could be given and the sequence of signalling had to be completed before the winder motor could start. Several times during visits signals failed to complete the sequence, possibly because of a dirty switch contact, and the winding engineman, who was on duty to attend to the machine and the complex mechanism, was able to cancel the signals when the sequence began again. On completion of the sequence the machine started. On winders fitted with push-button control, the banksman and onsetter at pit bottom or inset levels had to close the necessary gates and complete the gate and brake electrical-interlock system before the push-button completed the signalling system and started the motor.

During the year Mr. Cowan visited two testing stations and the experimental mine of the U.S. Bureau of Mines; manufacturers' works; coal mines; and an opencast strip mine. Trolley locomotives, operating chiefly on the rail return system, are used extensively in mines in the United States, and he gathered that the voltage in about 90 per cent of the installations did not exceed 250 d.c. He also saw a number of push-button operated, electric, multi-rope, friction-drive winders, chiefly at shafts not exceeding 660ft in depth and operated on lines similar to lifts in buildings in this country. They were used for winding men and materials only. The "banksman" travelled in the cage as the attendant and operated the lift from the cage. The surface, pit bottom and inset gates, if any, were interlocked with the gates on the cage. On at least one installation there was provision for telephone communication between the cage, surface, pit bottom and insets.

The total horse-power of electric motors in use for all purposes at mines under the Coal Mines Act, 1911, at 30th June, 1954, was 3,667,590. The total number of motors in use was 120,820. The figures for 1953 were 3,455,383 h.p. and 112,104 motors, respectively. Table I gives an analysis of these motors and capacities in respect of their use, for 1954.

Electrical Accidents

There was only one fatal accident during the year. It resulted from electric shock and occurred on the surface when a fitter was handling a defective hand-held drilling machine. There were 61 non-fatal accidents resulting in injury to 74 persons; 34 were injured at the surface and 40 underground. In addition, there were 18 dangerous occurrences. Of the persons involved, 51 were electricians —13 more than in 1953 and the highest number for many years. Table II shows the nature and causes of accidents in 1953 and 1954.

In the one fatality a fitter, aged 54 years, received a shock when handling a portable electric hand-held drilling machine in the surface fanhouse at a Yorkshire colliery. The drilling machine was supplied with power at 230 V from one phase and neutral of a 400 V, 3-phase system, with the neutral point earthed. The fitter, together with the foreman fitter, was engaged in erecting a metal guard

TABLE I.—NUMBER AND H.P. OF MOTORS IN USE

Surface			Underground		
Duty	No. of motors	Horse-power	Duty	No. of motors	Horse-power
Air-compressing	1,375	264,445	Staple winders ...	49	6,337
Winding ...	943	291,344	Air-compressing ...	1,139	53,970
Ventilation ...	1,565	186,125	Haulage	11,755	572,524
Haulage ...	2,379	111,444	Conveyors	20,025	494,483
Coal-cleaning	16,769	329,365	Coal loaders ...	452	16,684
Miscellaneous	25,414	349,818	Stone loaders ...	299	7,568
			Pumping	12,596	543,349
			Coal-cutting ...	7,969	372,358
			Coal-drilling machines... ...	11,078	14,593
			Stone-drilling machines... ...	1,793	2,587
			Other portable machines... ...	500	6,599
			Auxiliary ventilation	3,155	27,789
			Miscellaneous ...	1,565	16,208
Totals ...	48,445	1,532,541	Totals ...	72,375	2,135,049

over the recently installed V-rope drive for the ventilating fan. The guard had been made in sections and a drilling machine was being used to drill holes through the sections, studs being used to secure the sections together.

During the erection of the guard, the fitter using the machine was standing on a wood trestle and the foreman was steadying the guard. When one of the holes was being drilled, the power supply to the machine and the lights in the fanhouse failed. The fitter laid the machine on the floor and went for an electrician. The electrician examined the fuses in the switch situated in the fanhouse controlling the lights in the building, and found that one of the fuses had blown. He replaced the fuse.

The fitter then went back to try the drilling machine. The foreman fitter, who remained behind a short time with the electrician, heard the drilling machine start up. Almost immediately afterwards they heard the fitter call out. The electrician ran upstairs to switch off and the foreman ran towards the fitter, whom he found lying on the steel plate floor with the drilling machine, which was still running, in his right hand and lying across his chest.

An examination of the drilling machine and associated apparatus showed that a three-core 23/·0076 t.r.s. flexible cable about 18ft in length was connected to the machine. The cores were coloured red, black and green. The earth core was not connected to the casing of the machine although the ends of the wires were making intermittent and quite accidental contact with the casing. At the other end of this cable the earth conductor was cut off short and the other two conductors were connected to the terminals of a bayonet-cap adaptor.

The drilling machine was a ¼in, heavy duty, portable, a.c./d.c., 220/250 V type with a casing of light alloy, die-cast construction. There was a pistol-grip handle on the machine with a trigger-operated, double-pole 10 A switch which was depressed for "on" and returned to "off" under the action of a spring.

The insulation of one of the leads between the switch and the motor had been abraded, apparently by the movement of the spring of the locking push-button. The insulation of the lead was split and there was evidence of slight fusion on the spring, suggesting that contact between the spring and the live conductor had resulted in the metal casing of the drilling machine becoming live.

TABLE II.—ACCIDENTS AND CAUSES

	Fatal		Non-Fatal	
	1953	1954	1953	1954
Nature of Accident—				
Electric shock and/or burns	2	1	56	57
Ignition of firedamp or coal dust ...	—	—	3	3
Fire arising from electrical defects ...	—	—	16	12
Other causes	1	—	7	7
Totals	3	1	82	79
Contributory Causes—				
(a) Design or unsuitability of apparatus	—	—	9	5
(b) Installation or maintenance ...	—	1	22	22
(c) Misuse, negligence, ignorance ...	2	—	50	49
(d) Organization and lack of equipment	1	—	1	2
(e) Unforeseeable	—	—	—	1
Totals	3	1	82	79
Apparatus Involved—				
Switchgear and fuses	2	—	51	45
Flexible cables and plugs	—	—	17	10
Overhead lines, bare or insulated ...	—	—	—	1
Unarmoured cables, and wiring in conduit	—	—	2	—
Lighting accessories	—	—	—	—
Motors and transformers	—	1	3	7
Coal-cutting machines	—	—	1	4
Armoured cable and accessories ...	1	—	7	11
Signalling bells	—	—	—	—
Miscellaneous or unknown	—	—	1	1
Totals	3	1	82	79

SEVEN YEARS OF NATIONALIZATION

Central Electricity Authority's Review

UNDER the title of "Seven Year Record—1948 to 1955" the Central Electricity Authority has just published a booklet which briefly reviews the outstanding developments of electricity supply in Great Britain during the first seven years of national ownership and operation under the British Electricity Authority and the fourteen Area Electricity Boards set up by the Electricity Act of 1947. Vesting Day was 1st April, 1948, and the data and records cover the period up to 31st March, 1955. The national organization was modified by the Electricity Reorganization (Scotland) Act of 1954 which merged the former South West and South East Scotland Electricity Boards, and the corresponding Generation Divisions of the British Electricity Authority, into the South of Scotland Electricity Board as from 1st April, 1955. At that date the title of the British Electricity Authority was changed to Central Electricity Authority. The following are a few interesting extracts from the booklet.

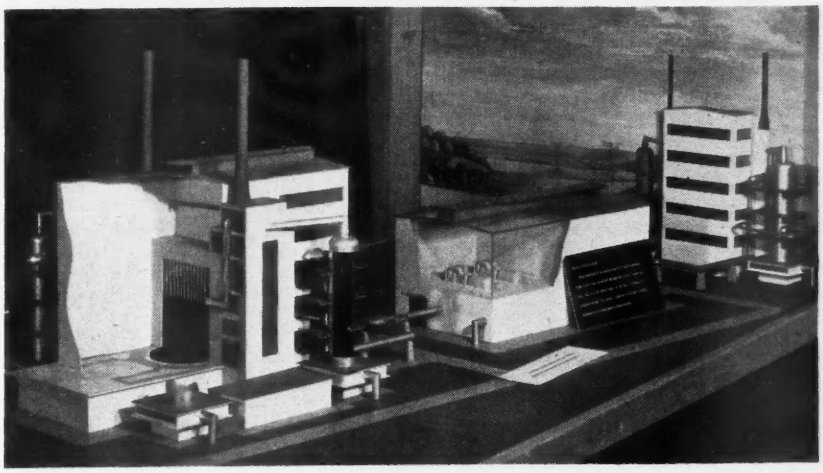
Expansion has taken place from the small isolated power stations and distribution networks of fifty years ago, serving hundreds or at most a few thousand consumers, to the giant thermal and hydro plants of to-day, interlinked by transmission systems operating at hundreds of thousands of volts and serving, in the ultimate transformation, millions of consumers. To-day, on the threshold of the harnessing of nuclear energy for power development, the vista of future electricity expansion is not merely undimmed; it is of increasing brightness. And the trend to international co-operation, collaboration and even integration grows stronger.

The grid, operating at 132 kV, was virtually completed in 1936. It enabled excess plant—formerly necessary in each isolated station to permit periodic overhaul, and as safeguard against breakdown—to be reduced from about 80 per cent to 20 per cent. Through the years economies of millions of pounds were effected in capital expenditure. Moreover, as a result of the facility the grid provided for operating the most efficient plant to meet the varying load at each hour of the day and night, average generating costs were progressively reduced and a great saving of coal was secured. Shortly before the second world war started the experiment was tried of operating the whole of the grid system solidly interlinked. The experiment was a success and the national supply system has been so operated ever since.

The impact of post-war conditions on electricity supply was three-fold. First there was a shortage of generating plant following virtual cessation of power station construction during the war; the shortage was of the order of 2,000,000 kW, or 15 per cent to 20 per cent of requirements. Secondly the demand for electricity had begun to rise again rapidly as soon as hostilities ended, there being an increase of 37 per cent over the five-year period 1946-50. In the winters of 1949, 1950 and 1951 plant shortage

became increasingly serious and it was necessary to appeal to consumers to go easy with electricity consumption at times of peak demand and to ask them to spread their use of electricity throughout the working day. Despite a good response temporary disconnection of large groups of consumers was unavoidable on many occasions.

Notable advantages have resulted from national co-ordination of electricity supply in Great Britain. These stem partly from centralization of ownership and control, partly from organizational economies, but mainly from the improvement in efficiency brought about by increasingly large-scale operation. In the generation of electricity outstanding savings have been effected through the installation of larger and more efficient plant and its co-ordinated operation under central direction. The average overall thermal efficiency of operation of all power stations was 20·87 per cent in 1947-48. By 1953-54 the corresponding figure was 23·40 per cent and in 1954-55 it was 23·85 per cent.



Model of future C.E.A. nuclear energy power station

Larger Generating Units

Before vesting day there were few sets actually in operation with outputs in excess of 30,000 kW. There were only about half a dozen 60,000 kW or larger sets in commission; the largest unit was the 105,000 kW set at Battersea power station. In the annual plant construction programme in the early post-war years 60,000 kW sets were prominent and in the later years the 30,000 kW size has tended to fade out of the picture as larger and larger units—up to 200,000 kW—have been ordered. The following figures of estimated thermal efficiency scheduled are indicative of the economies inherent in the current programme.

Turbo-Generator C.M.R.	Pressure at Turbine S.V.	Temperature at Turbine S.V.	Reheat Temperature	Expected Test Efficiency on Basis of kWh Generated. Vacuum 28·9"	Number by 1960	Capacity of unit Boiler
MW	P.s.i.g.	°F	F	%		klb hr
30	600	850	—	29·3	39	300
60	900	900	—	31·9	105	550
60	1,500	1,050	—	33·7		
100	1,500	1,050	—	34·5	15	830
100	1,500	975	950	35·4		
120	1,500	1,000	1,000	35·8	16	860
200	2,350	1,050	1,000	37·6	3	1,400

The supergrid of main transmission lines operating at 275 kV will also secure substantial economies. It has a different purpose from the 132 kV grid on which it is superimposed, in that its function will be to transmit power in bulk to various parts of the country to points where it will be fed into the 132 kV grid and further distributed in the usual way.

Another project that should secure substantial financial economy in the years ahead is the cross-Channel submarine cable linking the national supply networks of Electricité de France and the Central Electricity Authority. It is, of course, a joint project of the two national organizations and it is based on the fact that the peak demand of the day does not occur at the same time in both countries. Investigation suggests that the difference in incidence would probably be at least 300,000 kW. Certainly there is a firm difference well in excess of 100,000 kW, which is the power it is planned will be imported and exported between the two systems. The 100,000 kW capacity cross-Channel 132 kV cable link project will cost some £4·3 million in capital expenditure. Its existence will avoid the necessity of installing 100,000 kW of additional plant in each country and this will make possible a net saving in capital costs estimated at between £5 and £6 million for each of the two sponsoring organizations. In addition it may be that on occasions Electricité de France will be able to export to Britain cheap "spill-over" power from its vast hydro-electric developments.

Assisted Wiring Schemes

THE London Electricity Consultative Council has turned down a proposal by London Borough Councils that it should support their claim for a revival of assisted wiring schemes. The Councils had approached this body after their suggestion that Electricity Boards should be required by law to introduce wiring schemes had been rejected by the Minister of Housing and Local Government and the Minister of Fuel and Power. Reporting to the Metropolitan Boroughs' Standing Joint Committee, the Consultative Council says it is impressed by the main objections made by the London Electricity Board to the introduction of assisted wiring schemes.

The first of the five main objections raised by the Board was that schemes of this nature operated by most undertakings were to secure a more rapid adoption of electricity supply. In the Board's view, it was no part of the object of the schemes to relieve existing consumers of the responsibility for maintenance of their installations.

It was also pointed out that the reintroduction of those schemes by the Board could not be confined to any one class of consumer but must, of necessity, be available to all, and that the operation of such schemes would be a "considerable drain" on the Board's permitted expenditure. It submitted that as installations in private residences formed part of the landlords' fixtures, responsibility for replacing them should fall on the owners.

The Standing Joint Committee is now telling member Councils that it does not feel that it can usefully take any further action in the matter.

New Books

Law and the Engineer. By Christopher F. Mayson, A.M.I.E.E., Barrister-at-Law, with foreword by the Rt. Hon. Sir Alfred Denning. Pp. 470. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 63s.

The author, who is well known to readers as a contributor to the *Electrical Review*, says in his preface that his aim has been to present to engineers in a practical and understandable manner certain aspects of the law which are likely to be of interest or concern to those engaged in the design, manufacture, sale, installation, maintenance or repair of engineering equipment.

The book is not a substitute for a lawyer but is designed to give the engineer some idea of the legal aspects of transactions in which he is likely to be involved and of his rights and obligations.

The first part is a brief review of the scope of the civil law, evidence and general matters. Part two is the longest section. It deals with many aspects of the law of contract, including the framing of contracts, their fulfilment or discharge, express and implied terms, remedies for breach of contract, agents, hire-purchase agreements, export contracts and contracts of employment. Monopolies and agreements in restraint of trade are touched upon.

The law of negligence forms the substance of the third part and the responsibilities of employers towards their employees and of "occupiers" towards the public are among the matters treated. There are appendices on the responsibilities of professional engineers, standard conditions of engineering contracts and the Factories Acts, a bibliography, glossary and index.

The cases quoted by the author are both apposite and illustrative of the working of English law. Engineers should find Mr. Mayson's book not only useful but also interesting reading matter.—J.H.C.

The Gas Turbine Manual. By R. J. Welsh and G. Waller. Second edition. Pp. 279; figs. 150. Temple Press, Ltd., Bowling Green Lane, London, W.C.2. Price 30s.

This book provides an excellent survey of modern British and foreign gas turbines in all fields excluding aircraft propulsion. The material is mainly descriptive and is amply supported by clear diagrams and photographs and extensive tables of design data. Such information is useful to all interested in gas turbines. The book is written primarily for users and buyers as it provides a guide to current gas turbine practice.

Different types of turbines for naval and merchant service use, process work, power stations, locomotives and road transport vehicles are described in fair detail.

The overall survey reveals the ways in which gas turbines are being developed. In the detailed description of various turbines, the cycle employed, the performance attained and the construction, running experience and the history of the development are given. The principal requirements influencing the choice of a cycle are summarized and the reasons explained for choosing certain types. The many combinations of compound cycles are given in standard form and a comparison of three variants of a compound cycle is made in a simple manner so that the reader can understand the differences in part load performance and the general behaviour of each.

A chapter on running and maintenance will be useful to operators who have not had experience with gas turbines. It gives general advice on installation, starting, governing and load changing, shutting down and maintenance and shows that a good gas turbine is relatively straightforward to operate and maintain, provided it is run on an approved fuel.

The problems of fuel ash from residual oil and solid fuels and the manner in which these are being tackled are described. The authors say that as far as can be judged from the present state of the art, the ash problems of the coal burning gas turbine are likely to prove less difficult than the corresponding problems with residual oil fuels. Several builders however have succeeded in overcoming the ash problems of residual oil fuels, making their use in gas turbines an economical proposition. The coal burning gas turbine has yet to be proved economical.

Descriptions are given of the various components including the compressor, turbine and heat exchangers. Details of combustion chamber equipment for various fuels are described and the reader is given an insight into the development work on the burning of coal and peat in gas turbines. Brevity has led to an insufficient description of a number of points such as the Field cycle and the "constant alpha three" design of blading. One has to be aware of these details to appreciate their brief description.—J.F.S.

The Practice of Price Maintenance with Particular Reference to the Motor Industry. By K. C. Johnson-Davies, M.A.(Cantab.), T.D., barrister-at-law. Pp. 130. Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Price 15s.

Mr. Johnson-Davies has been chief executive of the British Motor Trade Association for over twenty years. Whilst drawing widely from his experience in the motor industry, he presents a comprehensive picture of the general law governing the powers and limitations of trade associations in the enforcement of collective agreements, the constitution of domestic tribunals and their position in law. In addition he puts forward constructive proposals for changes in the law. The book concludes with an analysis of, and commentary upon, the 1955 Report of the Monopolies Commission on Collective Discrimination.

BOOKS RECEIVED

The Generation of Electricity by Wind Power. By E. W. Golding, M.Sc.Tech., M.I.E.E., M.Amer.I.E.E., F.R.G.S. Pp. 318; figs. E. & F. Spon, Ltd., 15, Bedford Street, London, W.C.2. Price 50s.

The Electrical Engineer's Reference Book. Edited by E. Molloy. Pp. 2,184; figs. George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Price 70s.

Power System Plant. Edited by E. Openshaw Taylor, B.Sc., A.C.G.I., D.I.C., M.I.E.E., M.A.I.E.E. Pp. 307; figs. George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Price 30s.

Illuminating Engineering Course. By H. Zijl. Pp. 241; figs. Published by Philips Technical Library and distributed in the United Kingdom and Eire by Cleaver Hume Press, Ltd., 31, Wright's Lane, Kensington, London, W.8. Price 23s 6d.

The Cooling of Electric Machines and Cables. By Theodore De Koning. Pp. 233; figs. Zuid-Nederlandsche Drukkerij N.V.—'S-Hertogenbosch, Holland. Price $15 (red cover edition) and $5 (blue cover edition). The latter is not available to electrical manufacturers.

Ultra-Violet Visible Infra Rouge. By M. la Toison. Pp. 163; figs. Les Editions Eyrolles, 61, Boulevard Saint Germain, Paris, 5, France. Price 1,600 F.

McGraw-Hill Electronic and Radio Engineering Series. By F. E. Terman, Professor of Electrical Engineering. Pp. 1,078; figs. McGraw-Hill Publishing Co., Ltd., McGraw-Hill House, 95, Farringdon Street, London, E.C.4. Price 71s 6d.

Color Television Engineering. By John W. Wartworth. Pp. 459; figs. McGraw-Hill Publishing Co., Ltd. Price 60s.

Electric Power Stations. By T. H. Carr, M.I.C.E., M.I.Mech.E., M.I.E.E., M.I.F. Volume 1. Pp. 605; figs. Price 70s. Volume 2. Pp. 832; figs. Price 80s. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2.

GENERATION AND DEVELOPMENT

Mr. Harold Midgley, deputy chairman of the South Western Electricity Board, operates a switch to commission the 1,000th substation installed in Bristol. On the left of the photograph is Mr. P. M. Wilson, deputy manager, Bristol Sub-Area, and on the right, Mr. E. C. Willis, the manager

C.E.A. Contracts

Contracts have been placed by the Central Electricity Authority during the past two months for power stations, transforming stations and transmission lines amounting in the aggregate to £4,006,725. The principal contracts include:—

Marchwood power station, near Southampton: Structural steelwork for second extension.—Alexander Findlay & Co., Ltd.

Poole power station: High and low pressure pipework and valves.—Aiton & Co., Ltd. Two generator transformers.—Fuller Electrical & Manufacturing Co., Ltd.

Plymouth "B" power station: Two 60,000 kW turbo-generators.—British Thomson-Houston Co., Ltd.

Brighton (Southern Cross) substation: 132 kV switchgear.—English Electric Co., Ltd.

Eastbourne substation: Two 30 MVA, 132/11 kV transformers.—Crompton Parkinson, Ltd.

Fleet substation: 132 kV switchgear and 275 kV connections.—Metropolitan-Vickers Electrical Co., Ltd.

Rochdale substation: 275 kV switchgear.—English Electric Co., Ltd.

Year's Output

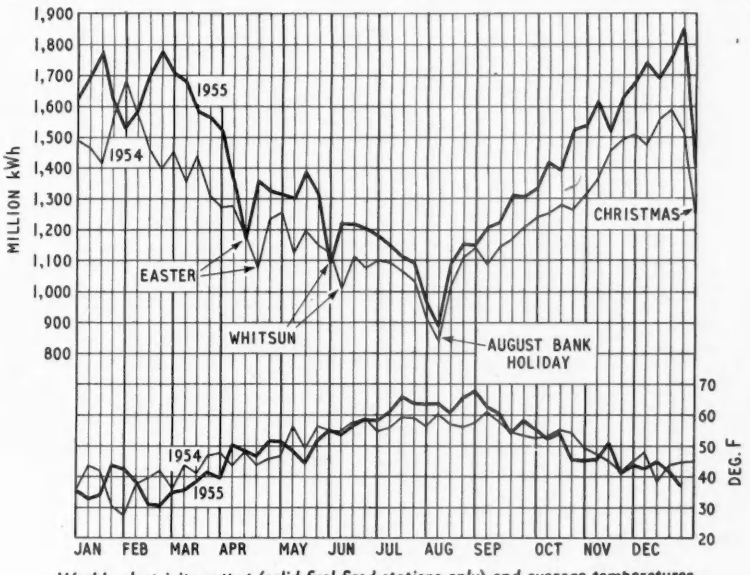
The weekly statements issued by the Ministry of Fuel and Power show that during the 52 weeks ended 30th December last 73,547 million kWh was sent out by solid-fuel fired power stations for public supply. This compares with 66,223 million kWh in the corresponding 52 weeks of 1954, an increase of 7,324 million kWh, or 11 per cent. Although the weather in the early part of last year was severe the summer months were generally warmer than in 1954 and the average temperature for the two years was very similar (48·9 deg F in 1954 and 49·0 deg F in 1955). These temperatures compare with an average of 49·6 deg F for the thirty years 1921-50.

Thousandth Bristol Substation

At a ceremony to mark the installation of Bristol's 1,000th electricity substation on 2nd January, Mr. Harold Midgley, deputy chairman of the South Western Electricity Board, said that the city's fine record of progress in industry, commerce and new housing was reflected in the remarkable growth in the demand for electricity, which had increased by nearly 70 per cent in only seven years. The substation "taps" the Board's mains network in the city to provide power for the new saw mills of Southerns, Ltd., at Hartcliffe Way, Bedminster.

Work was progressing rapidly on the new shopping centre, said Mr. Midgley, and big schemes were being prepared for power supplies to multiple stores and other premises in the Horsefair and Fairfax Street areas, which would help to make Bristol the major shopping centre for a very wide area. To keep pace with the city's great housing programme, the Board's engineers had provided a network of 130 miles of cable and installed about 70 substations on the city's housing estates.

Mr. E. C. Willis, manager of the Bristol Sub-Area, said that it was exactly 75 years ago this month that a street lighting experiment was carried out in the city and seven street lamps were erected in the four main streets converging on the Council House. The first public supply of electricity was given in August, 1893. They had averaged well over one substation a month since the inception of the undertaking. Difficulties in finding suitable sites had necessitated over 100 substations being placed under the streets.



Weekly electricity output (solid-fuel fired stations only) and average temperatures

Supplies to Boarding Houses

When tariff increases were proposed it always seemed to be a rush job, but when it was a question of an improvement there seemed to be interminable delay, said Ald. W. J. Bennett, chairman, at last week's meeting of the Eastern Electricity Consultative Council. He was referring to the report of the Tariffs Sub-Committee which expressed concern at the length of time taken by the Central Authority's Retail Tariffs Committee to reach a decision on a national basis on tariffs for supplies to small hotels, boarding houses, hostels and similar premises. This matter came before the Council about a year ago, when it was suggested that the Board should ask the Central Authority for guidance.

Thermal Storage Heating in Schools

The Fens Local Committee of the Eastern Electricity Consultative Council recently decided to ask the Board for any information which might become available as to the efficiency and costs of thermal storage heaters in schools and office buildings. One member thought there was some reluctance on the part of local authority architects to recommend night storage heaters for schools. At the meeting of the Consultative

Council last Friday Ald. Bennett said that they had been informed that one school was being equipped with this form of heating. If it was a success it would enable great economies to be made in school building costs.

Royal Opening of Calder Hall

The nuclear power station at Calder Hall, Cumberland, will be opened by the Queen on 17th October next, when it will be connected with the national grid system.

Nuclear Station Site in Essex

Subject to various reservations as to water supply and planning, Essex County Council last week approved in principle the proposal of the Central Electricity Authority to construct a nuclear power station on a site near the airfield at Bradwell-on-Sea. A committee of the Council reported that housing would be necessary for 200 to 300 employees. It stated that there were indications that objections would be lodged by local people and societies. These included the Essex Bird Watching and Preservation Society, who had pointed out that the site was only 1½ miles from a suggested nature reserve, and would be in the centre of a well-known sanctuary for birds.

Scottish Hydro-Electric Schemes

During 1955 the North of Scotland Hydro-Electric Board commissioned an additional 126,900 kW of generating plant in six stations, the latest to be brought into operation being the Finlarig station in Perthshire and the Mullardoch station in Inverness-shire.

The Finlarig generating station on the shore of Loch Tay is the station of the Lawers section of the Breadalbane scheme. The generator, with a horizontal shaft and a capacity of 30,000 kW, is the largest machine of its type installed in this country. The alternator is driven by two twin jet overhung Pelton turbines with a combined output of 42,000 h.p. The machine operates under a head of 1,360ft, the highest of any station so far built by the Board. Its annual output will be about 80 million kWh. The water to operate the Finlarig power station is stored in Lochan na Lairige, lying 1,620ft above sea level on the high pass between Loch Tay and Glen Lyon, where a dam is at present under construction.

The Mullardoch station is nearly 90ft underground at the end of the 3¼ mile long tunnel between Loch Mullardoch and Loch Benevean. Access is by lift. The turbine, of relatively large dimensions, drives through bevel and reduction gearing a small asynchronous alternator. This is the largest machine of this type so far commissioned by the Board. It has a capacity of 2,400 kW and is estimated to produce about 8 million kWh per annum.

The civil engineering consultants for the Lawers scheme are Messrs. James Williamson & Partners, and the electrical consultants Messrs. Merz & McLellan, the main civil engineering contractors being the Cementation Co., Ltd. The generating plant was manufactured by the British Thomson-Houston Co., Ltd., and John Brown & Co. (Clydebank), Ltd., for Boving, Ltd. The civil engineering consultants for the Mullardoch power station are Sir William Halcrow & Partners and the main civil engineering contractors are Reed & Mallik. The generating plant was manufactured by Bruce Peebles & Co., Ltd., and Gilbert, Gilkes & Gordon.

New Mauritius Station

A new diesel engine generating station has just been opened at Port Louis by Sir Robert Scott, Governor of Mauritius. When it is completed it will contain four Mirrlees/Brush sets. The need for the station was urgent as the speed with which the work was carried out shows. The design was completed in March, 1954, and contracts were let in April and building began in May. The generating hall was completed and the first set was running by 24th December, 1954. The building has been designed to withstand the island's frequent tropical cyclones.

Two sets are now installed. Each consists of a Mirrlees, Bickerton & Day KVS12 twelve-cylinder, vee-form, pressure - charged diesel engine, developing 2,484 b.h.p. at 428 r.p.m., directly coupled to a 1,742 kW alternator manufactured by the Brush Electrical Engineering Co. The third set, being installed, and the fourth, now on order, each consists of a Mirrlees KVSS12, twelve-cylinder, vee-form, pressure-charged diesel engine with air intercoolers, developing 2,788 b.h.p. at 428 r.p.m., directly coupled to a Brush 1,968 kW alternator. The order was obtained through Forges Tardieu, Ltd., the Mirrlees/Brush agents in Mauritius.

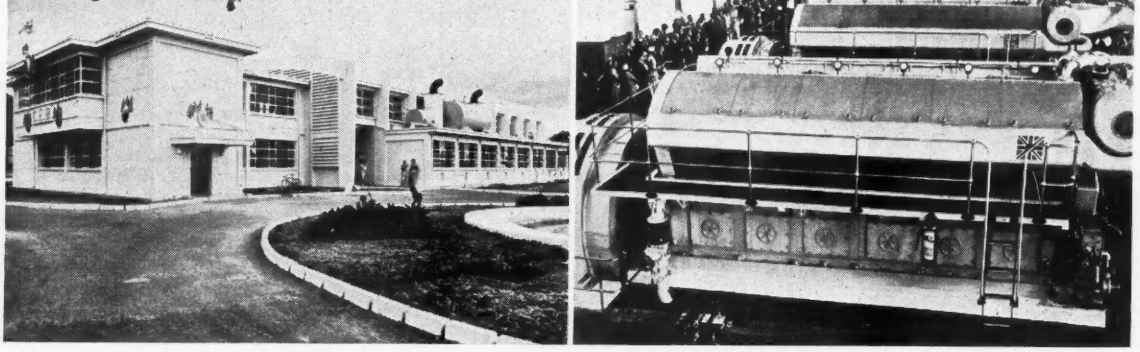
Atomic Piles in France

The French Commissariat for Atomic Energy announced last week that the first of two atomic piles at Marcoule (Gard) had been started up. It is a plutonium producing plant and will also provide heat for the generation of electricity.

Waikato River Activity

Four hydro-electric schemes will soon be under construction at the same time on the Waikato River, in New Zealand, their eventual aggregate capacity being about a quarter of the power contemplated under the ten-year development plan for the river. The Ministry of Works now has a force of over 1,200 men engaged and in addition there are 250 men employed by contractors.

The four stations are those at Whakamaru, Ohakuri, Atiamuri and Waipapa. The 100 MW Whakamaru station is nearing completion and it is hoped to have half of the plant in operation in time to avoid serious black-outs in the North Island this year. The next most advanced station is that at Atiamuri, work at which is being speeded up. At Waipapa, the furthest hydro-electric project downstream from Ohakuri, excavation of the diversion channel is still under way. A temporary access bridge is being built and works offices erected. To date only Ministry of Works investigations have been carried out at Ohakuri.

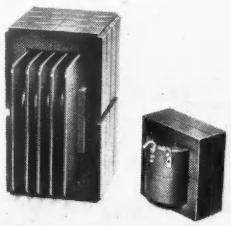


Port Louis power station, Mauritius, and (right) the first two Mirrlees/Brush sets

NEW ELECTRICAL EQUIPMENT

High Frequency Power Transformers and Chokes

The Components Division of MULLARD, LTD., Century House, Shaftesbury Avenue, London, W.C.2, is now manufacturing high frequency



Typical Ferroxcube-cored h.f. power transformers

power transformers to customers' requirements. The use of Ferroxcube as the core material enables efficient operation to be achieved over the frequency range 2 kc/s-20 Mc/s and powers up to 1 kW can be handled. Such transformers are used in aircraft high frequency power supplies, ultrasonic equipment, r.f. output stages, and high frequency fluorescent lighting installations. In addition to their excellent electrical performance, the weight of these transformers is often less than that of iron cored components.

Inductances for smoothing and interference suppression are also made by Mullard. These range from low-current high inductance (up to 200 H) types to high current low inductance types used for suppressing power supply circuits.

The larger transformers and chokes use Ferroxcube "U" cores. Where only moderate amounts of power are involved, however, it is possible to use Ferroxcube pot cores, which have the advantages of a low external field and lower winding capacities.

The larger of the transformers illustrated measures 4¾in by 2¼in by 2¼in and has a power rating of 1 kW at 20 kc/s.

Fluorescent Reflector Lamp

The introduction of a new fluorescent reflector lamp is announced by PHILIPS ELECTRICAL, LTD., Century House, Shaftesbury Avenue, London, W.C.2.

In appearance, the new lamp is a standard fluorescent tube. Two-thirds of its inner surface are, however, coated with a special reflecting phosphor in addition to the usual fluorescent material. By this means, it is claimed, the bulk of the light output is distributed over 120 deg without the need for a separate reflector. In industry, where dirty atmospheres may well reduce the efficiency of a lighting installation by as much as 30-40 per cent, making frequent cleaning a necessity, it has many advantages and for the lighting of shop windows it makes the fullest use of light output by concentrating illumination upon the area of display. Glare is also reduced.

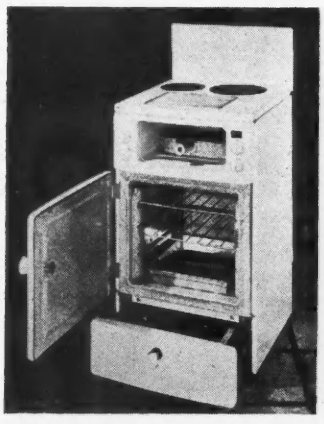
The new lamp is at present available only in "Cool White" in the 4ft 40 W rating. The price is 13s 9d plus 2s 10½d purchase tax.

Domestic Cookers

The introduction of a completely new range of electric cookers is announced by the JACKSON ELECTRIC STOVE CO., LTD., 143, Sloane Street, London, S.W.1. Known as the "390" series of cookers they are of pleasing appearance, a special feature being their bow front, the line of which is carried through to the hob. The door handle has been specially designed to give an easy grip. The large full width oven (3,000 cu in) is loaded at 2,500 W and is capable of accommodating a 30 lb bird. It is thermostatically controlled and an average cooking temperature is reached within 15 minutes. The oven interior is finished in light acid-resisting vitreous enamel, as are the element guards, which are removable for easy cleaning.

The hob can be lifted off and it is fitted with one or two solid boiling plates (depending on the model) in addition to a 10½in grill boiling plate. Radiant plates can be fitted as optional extras. The 8in plate is fitted with a "Simmerstat" control and the 6¼in plate has a three-heat switch with a "Simmerstat" as optional extra.

The open grill chamber is sufficiently wide to accommodate full-sized dinner plates horizontally and is of one piece welded steel construction. Rounded corners and a spillage trough at the base make for easy cleaning.



One of the Jackson "390" series of cookers—3-plate, drawer model

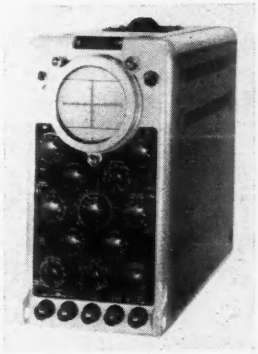
The waist-high switches and controls are easy to regulate and read and the thermostat is provided with a neon light which automatically cuts out when the oven is ready for use.

The range of cookers is supplied on legs, with plinth, or with storage drawer, and not only the front and the interior but also the sides of the main body are of acid-resisting vitreous enamel. All models are supplied in either all-cream or all-white finish. The height is 36in to hob (45in with the splashplate) by 20½in wide by 22¼in deep at centre (21½in at sides).

The price of the 2-plate, leg model is £27 and of the 3-plate, leg model £29 4s, while the prices of the plinth and drawer models are, 2-plate, plinth £27 17s; 2-plate, drawer £29 11s; 3-plate, plinth £30 1s; 3-plate, drawer £31 15s.

Single Beam Oscillograph

Designed for laboratory use, the new model 1058 oscillograph introduced by COSSOR INSTRUMENTS, LTD.,



Cossor model 1058 oscillograph

Highbury Grove, N.5, provides a Y amplifier with a very useful frequency characteristic extending from d.c. to 6 Mc/s. The display is presented on a new post deflection accelerator tube at an amplitude of not less than 6 cm over the stated frequency band. The maximum sensitivity of the channel is 0·25 V/cm and calibration is effected by means of the accurate test voltage provided. The time base of the instrument can be switched to fire repetitively or by a trigger pulse of either sign derived from the Y amplifier signal or externally. A special refinement, of interest to television engineers, is the provision for triggering from the frame or line sync. pulse in a 1 V D.A.P. (positive) composite video signal.

Five calibrated time base ranges are provided, giving spot velocities from 0·5 V/cm and bandwidth 20 c/s-250 kc/s (−50 per cent) is included and allows time base expansion, continuously variable, of up to five times. Time measurement is by calibrated shift control.

Financial Section

STOCKS and SHARES

STOCK EXCHANGE markets are feeling their way forward into 1956 with caution, which was heightened by the news of curtailed production in the motor industry. Few of the many annual forecasts which appear at this season have given the investor much encouragement to do anything but maintain a position on the fence. Holders of ordinary shares are advised of the difficulties likely to affect industrial production costs and profit margins, but are reminded that good equities provide one of the best forms of shelter for capital so long as the forces of inflation remain only partly tamed. In the latter connection, all sections of the Stock Exchange are in a state of expectancy over the line to be developed by the new Chancellor of the Exchequer.

Price Changes

In the market for electrical equipment shares, a distinctly easier tendency is apparent in the shares of the big groups. Little change was registered in the official quotations, but in the market, A.E.I. at 80s, English Electric at 62s 6d, and several others were reflecting losses. By way of explanation, a substantial new issue of capital by one of the leading firms was being rumoured. Elsewhere, both S. Smith and Lucas shares showed improvement at first, although issues connected closely with the motor industry were generally affected later by the latest news from the trade. Veritys were marked up sharply. Electric & Musical Industries and Tube Investments retained most of their substantial rises of the previous week.

Investment Selection

Electrical shares selected for special mention in the New Year review of a Stock Exchange firm of dealers in engineering issues include those of W. T. Henley's Telegraph, Thorn Electrical, and A.E.I. (Australia). The first are selected on the strength of the improvement which gained ground in the cable industry during the course of 1955, and of the relatively high yield of over 6 per cent on the 10s shares at 17s 3d. Thorn Electrical 5s shares at 22s 6d show a current yield of not much more than 3¼ per cent, but attention is called to the very conservative rate of the dividend, and to the company's progress in the fields of fluorescent tubes, colour television and electronics generally. A.E.I. (Australia) £1 shares, a note on which appeared here last week, are quoted at 21s 6d to yield 5½ per cent.

Westinghouse Results

Westinghouse Brake & Signal £1 shares have been unsettled since the news of the reduction in earnings during the year ended in September. After being nearly £5 in advance of the announcement, the price was marked down subsequently to under £4½; the quotation is ex the final dividend, but cum-rights to an issue of new shares. The fall in the group

The Week's Price Changes

Company or Board	Nom. Value	Middle price 9th Jan.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1955 Highest	1955 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	79⅛	−1	3	3	—	94½	76⅛
Brit. Elec. 1974/77	100	78⅛	−1	3	3	—	93⅛	75⅛
Brit. Elec. 1976/79	100	83½		3½	3½	4 3 9	98⅜	80½
Brit. Elec. 1974/79	100	94½		4¼	4¼	4 10 0	109	90½
Overseas Electric Supply								
Calcutta Elec.	£1	20/6	−3d	6†	6†	5 17 0	22/6	20/9
East African Power	£1	20/6	+6d	7	7	6 16 6	24/6	19/9
Nigerian Elec.	£1	21/6		10	10	9 6 0	27/-	21/-
Palestine Elec. "A"	£1	21/-		Nil	Nil	Nil	22/9	21/-
Perak Hydro-Elec.	£1	17/6		10	10	—	22/3	17/9
Equipment and Manufacturing								
Aberdare Cables	5/-	12/9		12½	17½	6 17 3	14/6	11/-
Aerialite	1/-	6/6		88⅛	45*	6 18 6	6/9	5/3
Allen, W. H.	£1	77/-x.d.	+1/9	20	20	5 4 0	83/9	74/6
Aron Elec. Ord.	£1	55/6		15	15	5 8 0	63/9	55/6
Assoc. Elec. Ord.	£1	80/-	−3/9	11¼	14	3 10 0	96/-	62/6
Automatic Tel. & El.	£1	72/6	+1/9	15	15*	4 2 9	79/6	60/-
Babcock & Wilcox	£1	85/-	+1/3	12*	15	3 10 6	98/-	68/6
Baldwin, H.	2/-	5/-		20	20	8 0 0	5/6	4/4
Bakelite	10/-	33/6		2½	16	4 15 6	34/6	27/-
British Aluminium	£1	52/-	−6d	10	12	4 11 6	58/-	35/3
B.I. Callender's	£1	53/-		10	12½‡	4 14 3	55/3	44/9
B.I. Callender's 6% Pref.	£1	22/6		6	6	5 6 9	26/6	21/9
British Thermostat	5/-	31/3		27½	27½	4 8 0	35/-	22/6
British Vac. Cleaner	5/-	8/6		25	30	—	10/-	6/6
Brook Motors	10/-	45/6		20	25	5 10 0	47/-	39/9
Brush Ord.	5/-	7/3		6	10	6 18 0	9/6	7/6
Bulgin, A. F.	1/-	7/-		30	45	6 8 6	8/-	4/-
Burco Dean	5/-	13/3	+9d	—	22½	8 9 9	17/3	12/-
Chloride El. Storage	£1	72/-	−1/-	12½	17½	4 17 3	77/6	58/6
Clarke Chapman	£1	97/6	+1/3	20	20*	4 2 0	102/6	68/9
Cole, E. K.	5/-	21/3	−9d	27½	17½*	4 2 4	25/6	18/3
Cossor, A. C.	5/-	9/9	−3d	10	15	7 3 10	14/-	8/9
Crabtree	10/-	29/-		20	20	6 18 0	34/6	27/6
Crompton Parkinson Ord.	5/-	15/-		20	16*	5 6 8	19/9	15/-
De La Rue	5/-	20/3		20	30	7 8 2	26/-	17/-
Decca	4/-	43/9	−9d	35	56¼*	—	48/9	31/-
Desoutter	5/-	32/6		20	25	3 17 0	35/-	25/6
Dewhurst	2/-	12/-		24	30	5 0 0	11/3	7/3
Dictograph Tel.	2/-	7/-		20	20	5 14 3	9/3	9/6
Dubilier Condenser	1/-	4/6		25	25*	5 11 0	5/7	3/1
E.M.I.	10	35/-	−1/3	10	15	4 5 9	37/-	25/3
Electrical Components	5/-	15/-		20	25	8 6 8	21/3	13/9
Elec. Construction	£1	29/9		15	8½	5 14 3	41/3	28/9
Enfield Cable Ord.	£1	19/-		Nil	Nil	Nil	25/3	18/6
English Electric	£1	62/6	−2/6	10	12½	4 0 0	86/9	54/3
English Electric 3½% Pref.	£1	14/-	−6d	3½	3½	5 7 3	16/9	14/-
Ericsson Tel.	5/-	42/6		25†	25*†	2 18 9†	46/6	29/-
Ever Ready	5/-	32/6		40	35*	5 7 9	38/-	22/3
Falk Stadelmann	£1	46/3		15	17½	7 11 3	52/6	42/-
G.E.C. Ord.	£1	62/6		12½	14	4 9 6	80/3	51/3
G.E.C. 6½% Pref.	£1	23/9		6½	6½	5 9 6	28/4	23/6
General Cables	5/-	16/9x.d.	—	30	30	8 19 0	17/-	15/-
Greenwood & Batley	£1	47/6		17½	17½	7 7 4	57/6	45/-
Hackbridge Cable	5/-	24/3	+6d	20	25	5 3 0	23/9	14/-
Hackbridge & Hewittic	5/-	20/9		25	30	—	24/9	17/-
Hall Tel. Acc.	10/-	34/-		10	10	2 18 9	32/-	11/-
Heatrae	2/-	5/-		12½	15	6 0 0	5/9	4/3
Henley's	10/-	17/3		10½	10½	6 1 9	21/3	15/9
Holophane	5/-	18/9		25	30	8 0 0	19/9	16/-

* After scrip issue. † Free of income tax. ‡ Dividend forecast.

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.

profit from £1·6 million (for 53 weeks) to £1·3 million was ascribed, in the preliminary statement, partly to the effects of last year's industrial stoppages, and partly to the national wage awards. There is no difficulty in maintaining the dividend for the year at 18 per cent, and the full report issued this week gives an encouraging account of further prospects.

Capital Issue

With the annual accounts, Westinghouse Brake & Signal announce an issue of 615,239 new £1 shares, to be offered to existing stockholders in the proportion of three at 70s per share for every ten held. Proceeds of the issue, amounting to some £2·1 million, are to be used in paying off bank loans, in increasing productive capacity and providing fresh working capital. A quotation of 89s for the existing shares indicate an "ex-rights" price in the neighbourhood of 84s 9d. Assuming, therefore, the maintenance of the dividend at 18 per cent, the shares are on a prospective yield basis of 4¼ per cent.

in Electrical Investments

Company or Board	Nom. Value	Middle price 9th Jan.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1955 Highest	1955 Lowest
Equipment and Manufacturing—continued						£ s d		
Hoover	5/-	38/6	−6d	45	70	—	52/6	35/6
I.C.I.	£1	49/3	+1/3	15	10*	4 1 3	61/9	38/3
Intl. Combustion	5/-	18/-		20	25	—	24/6	16/-
Johnson & Phillips	£1	46/3		15	15	6 9 8	52/6	39/6
Lancashire Dynamo	£1	47/6		14	15	—	56/5	37/3
Laurence, Scott	5/-	16/9		20	12½*	3 17 0	19/6	14/6
Lister, R. A.	£1	34/9xd	+9d	9·3	10	5 15 1	40/-	28/9
London Elec. Wire	£1	52/6	+6d	10	12½	4 15 3	61/3	50/6
Lucas, J.	£1	40/-	+2/-	7½	7½	3 15 0	56/6	38/9
Marryat & Scott	2/-	11/3	+1/-	25	30	5 6 9	13/-	9/6
Mather & Platt	£1	63/6	+6d	15	13·4*	—	75/-	48/-
Metal Industries	£1	27/-	+1/6	9	9	6 13 4	38/-	25/-
Midland Elec. Mfg.	£1	48/9		15	10*	4 2 0	55/-	44/-
Morphy-Richards	4/-	28/3		35	50	7 1 6	35/-	27/-
Murex	£1	69/6		15	20	5 15 1	67/6	49/3
Newman Ind.	2/-	2/9		10	10	7 5 6	3/6	2/4
Oldham & Son	1/-	3/-		17½	20	—	3/6	2/1
Parnall (Yate)	5/-	9/6	+1/3	8	14	7 7 4	13/2	7/3
Parsons, C. A.	£1	82/6		7½	10	2 8 6	100/-	56/-
Plessey	10/-	86/-	+1/-	20	30†	3 9 9	89/-	55/-
Pye "A" Deferred	5/-	20/9		20	12½*	3 0 3	32/9	14/3
Revo	10/-	12/-	−6d	9	9	7 10 0	15/6	12/6
Reyrolle	£1	105/-		13¾	15	2 17 2	127/6	89/-
Rheostatic	4/-	12/6		20	22½	—	14/3	9/3
Richardsons Westgarth	5/-	16/-		15	16⅝	5 4 3	19/-	11/-
Scottish Cables	4/-	17/3		27½	27½	6 7 6	22/6	16/3
Smith (England), S.	4/-	14/3	+9d	17½	17½	4 18 3	20/-	14/9
Southern Areas	£1	30/6		7½	10	6 11 3	38/-	27/6
Strand Elec.	5/-	8/3		17½	15*	9 1 9	13/3	7/6
Sturtevant	5/-	31/3		18·9	14·4*†	2 6 0†	35/9	21/-
Sun Elec.	£1	35/-		15	20	11 8 9	35/-	33/9
Switchgear & Cowans	5/-	17/-		10	20	5 17 9	17/-	11/-
Taylor Tunnicliff	5/-	14/3		12½	15	5 5 3	16/3	11/3
T.C.C.	10/-	43/9		30	25*	5 14 3	53/9	41/-
T.C. & M.	£1	33/6		8½	8½	5 1 6	40/9	29/3
Telephone Mfg.	5/-	8/3		10	10	6 1 3	11/6	7/9
Thorn Elec.	5/-	22/6		20	15*	3 6 8	33/-	13/9
Thornycroft	£1	48/9		15	15*	6 3 0	48/9	34/6
Tube Investments	£1	68/6	−6d	22½	14*‡	4 1 9	62/6	55/-
Vactric	5/-	18/9		10	15*	4 0 0	22/-	12/-
Veritys	5/-	9/6	+1/9	12½	12½	6 11 6	12/2	7/-
Walsall Conduits	4/-	13/6		70	70	—	17/3	12/-
Ward & Goldstone	5/-	37/6	−9d	50	30*	4 0 0	45/-	32/6
Watford	2/-	7/6		22½	25	—	8/9	6/3
Westinghouse Brake	£1	90/-xd	−7/6	18	18	—	110/-	82/-
West, Allen	5/-	14/6	+6d	17½	15*	5 3 6	16/6	8/-
Wolf Electric	5/-	26/3		17½	20	3 16 3	26/3	16/1
Trusts, Transport and Communications								
Anglo-Am. Tel.:								
A. Ord.	100	72½	+5	6	6	8 5 6	88	67½
Ord.	100	42½		3¾	3¾	8 6 8	54½	45
Anglo-Portuguese	£1	22/-		8	8	7 5 6	27/-	21/-
Brit. Elec. Traction:								
Def. Ord.	5/-	19/6	+1/6	50	22½*	5 15 6	24/3	19/-
Cable & Wireless:								
Ord.	£1	43/6		9	10	4 12 0	54/-	39/6
4% Loan	100	92½		4	4	4 6 6	100	92/-
Calcutta Trams	£1	25/6	−1/3	6†	7½†	5 17 9†	26/9	20/-
Cape Elec. Trams	£1	18/9		5½	7½	8 0 0	19/6	16/6
Marconi Marine	£1	32/-	+9d	10	10	6 5 0	41/3	31/3
Oriental Tel. Ord.	1/-	79/6	+2/-	16	—	—	102/6	72/6
Telephone Rentals	5/-	11/9		10	12½	5 6 6	13/6	9/6

Investment Trusts

Dealings began this week in the new £1 shares of Cable & Wireless (Holding) at a premium of 23s 6d on the price of 20s at which they are offered to stockholders. The occasion may be taken to recall that, for the investor who likes to spread his interests so as to cover as much ground as possible with a limited amount of capital, there are special attractions in the stocks of these big investment trusts. The difficulty of supplying the demand for such issues has been relieved since the war by the emergence of a normally free market in the ordinary stocks not only of Cable & Wireless (Holding), but also of the Globe Telegraph & Trust, and of Atlas Electric & General. All three have now emerged into the broad field covered by general investment business.

Wide Interests

Of the three Trust companies mentioned above, Atlas Electric's latest annual report showed the company to be holding 1,240 separate investments (of which 76 per cent were ordinary stocks) with a book value of £10¾ million, and worth £15½ million in the market. The £1 shares are quoted at 33s 9d to yield 3·9 per cent on the 6½ per cent dividend. Cable & Wireless held quoted securities to the value of nearly £17 million a year ago. The 5s ordinary shares at 43s 6d (ex-rights to the new issue), yield £4—12 per cent on the basis of last year's 10 per cent dividend: the interim payment for 1955 has been raised. The 5s shares of Globe Telegraph, which operates on a comparable scale, stand at 12s, yielding 4·2 per cent on the 10 per cent rate of dividend.

British Tabulating Machine

There has been little change in the price of about 46s 6d for British Tabulating Machine £1 shares since publication of the final dividend and the preliminary profits statement for the year ended last September. Group earnings rose further from £748,000 to £891,000, and the net figure after tax more steeply from £241,000 to £554,000. In leaving the distribution on the ordinary shares unchanged at a total of 9 per cent, the company is increasing substantially the sum of earnings put back into the development of the business.

REPORTS and DIVIDENDS

The Westinghouse Brake & Signal Co., Ltd., reports a group trading profit for the year to 1st October last of £1,308,780, as compared with £1,616,392 for the preceding 53 weeks. Taxation absorbs £615,006, and the net balance is £637,523 (against £767,500), of which £465,582 is attributable to the parent company. To the parent company's profit is added previous income and unrequired provisions of £29,256 and a balance brought in of £243,218, making £738,056 available. Capital reserve for replacement of plant and equipment receives £145,000 and research and development reserve £40,000. The ordinary dividend for the year is maintained at 18 per cent and £340,799 is carried forward. The report states that the reduction in the trading profit of the group is largely due to the national wages awards of 1954 and 1955, and the effects of the railway and dock strikes. The company absorbed the whole of the increased costs arising out of the award of April, 1954, without raising its selling prices and also absorbed part, but not the whole, of the award of April, 1955.

Hoare & Co. have underwritten the rights issue to stockholders in Westinghouse Brake & Signal Co. and to ordinary stockholders in the Consolidated Signal Co. The issue is of 615,239 £1 ordinary shares at 70s each. Provisional allotment is being made to stockholders on the basis of three shares for every 10 £1 units. The Consolidated Signal Co., as a holder of Westinghouse, is entitled to a provisional allotment of 117,600 shares. These are being provisionally allotted direct to Consolidated stockholders on the basis of three Westinghouse for every four Consolidated £1 ordinary units held. The proceeds of the issue, approximately £2,110,000 net, will not only be used to fund the balance of the indebtedness to bankers, at present approximately £1,250,000, but also with a view to increasing productive capacity and provide additional working capital.

Burco Dean, Ltd.—The net profits for the first financial period, from incorporation on 29th March, 1955, to 30th September last, are £221,771, after deduction of taxation. General reserve receives £50,000 and it is proposed to pay a final ordinary dividend of 15 per cent, making 22½ per cent for the period. A sum of £101,941 is carried forward.

New Companies

Engineering & Scientific Research, Ltd.—Registered 15th December. Capital £100. Consultants in the businesses of civil, mechanical, electrical and metallurgical engineers, etc. Directors: Dr. Honri R. De Vitre and L. W. Derry. Solicitors: Pollard Stallabrass & Co., 17, Victoria Street, S.W.1.

L. J. B. Electrical Factors, Ltd.—Registered 23rd December. Capital £5,000. Electrical contractors, etc. Directors: L. Lowe, R. Lowe, Mrs. Lily Lowe and J. A. G. Barton. Regd. office: 31, Stoney Street, Nottingham.

Modern Home Supplies, Ltd.—Registered 22nd December. Capital £100. Manufacturers and distributors of, agents for and wholesale and retail dealers in electrical goods of all kinds, radio and television sets, etc. Directors: L. Szpiro and S. Sanger. Regd. office: 46, Brook Street, W.1.

Sydney A. Lane, Ltd.—Registered 22nd December. Capital £1,000. Electronic and automation engineers, consultants, designers and manufacturers, etc. Directors: S. A. Lane and Kathleen J. Lane. Regd. office: 13, Cromwell Road, S. Kensington, S.W.7.

Immersion Heater Sales, Ltd.—Registered 21st December. Capital £100. Manufacturers, hirers out of and wholesale and retail dealers in and installers of electrical apparatus, etc. I. H. Haw is the first director. Regd. office: 160, Edmund Street, Birmingham, 3.

Cable Jointers & Engineering, Ltd.—Registered 20th December. Capital £1,000. Cable jointers, electrical engineers, etc. Directors: W. C. Porter and E. C. M. Tucker. Regd. office: 16, Chatsworth Gardens, Westerhope, Newcastle-on-Tyne.

Raes (Gosforth), Ltd.—Registered 17th December. Capital £300. Electrical engineers, etc. Directors: Mrs. Dorothy Rae and Mrs. June Jobe. Regd. office: 1, Ashburton Road, Gosforth, Newcastle-on-Tyne, 3.

Duride Battery Co., Ltd.—Registered 16th December. Capital £2,000. Electrical engineers and contractors, etc. Directors: H. Sourbuts and E. G. Brewer. Regd. office: 146, Talbot Road, Blackpool.

L. Barr & Co., Ltd.—Registered 17th December. Capital £10,000. Electrical specialists, engineers and contractors, etc. Directors: L. Barr, Mrs. Florence M. Barr and L. W. Barr. Regd. office: 8, High Street, Clacton-on-Sea, Essex.

Contemporary Electrical Appliances, Ltd.—Registered 13th December. Capital £100. Manufacturers of and dealers in electrical goods of all kinds, etc. Directors: J. Waldron and R. T. Dunmall. Regd. office: 38, Nunhead Lane, S.E.15.

Cable & Accessories, Ltd.—Registered 30th December. Capital £1,000. Electrical and mechanical engineers, etc. The first directors are to be appointed by the subscribers. Solicitors: Price Atkins & Price, 71, Temple Row, Birmingham, 2.

Douglas Gill (Heswall), Ltd.—Registered 30th December. Capital £100. Electrical engineers and contractors, etc. Directors: D. Gill and Beryl E. Gill. Regd. office: 173, Telegraph Road, Heswall, Cheshire.

Johnson Electrical Co. (B'ham), Ltd.—Registered 30th December. Capital £300. Installation, development and operation of radio and television relay equipment, etc. Directors: R. N. Johnson and Winifred Johnson. Regd. office: 1269, Pershore Road, Stirchley, Birmingham, 30.

Numismators, Ltd.—Registered 30th December. Capital £1,000. Electrical, electronic and nucleonic research and precision engineers, consultants and developers, etc. Directors: R. Josephs, T. R. Burton, D. Josephs, B. Leon and S. H. Mincoff. Regd. office: 105, Clayton Street, Newcastle-on-Tyne.

Increases of Capital

George H. Scholes & Co., Ltd.—Increased by £100,000, in 5s ordinary shares, beyond the registered capital of £200,000.

Glass Bulbs, Ltd.—Increased by £250,000, in £1 "C" ordinary shares, beyond the registered capital of £1,000,000.

Small Electric Motors, Ltd.—Increased by £10,000, in 200,000 ordinary shares of 1s, beyond the registered capital of £150,000.

Walton Testing Equipment Co., Ltd.—Increased by £23,000, in 2,000 preference and 21,000 ordinary shares of £1, beyond the registered capital of £2,000.

Bankruptcies

T. F. Mathias, Charles Court, Letterston, Pembrokeshire, electrical contractor.—Public examination 17th February at the Shire Hall, Haverfordwest.

G. S. Lacey, 74, St. Giles Street, Norwich, electrical engineer.—Receiving order made 29th December on debtor's own petition.

E. J. Thompson, 3, Queens Avenue, Muswell Hill, London, N.10, electrician.—First meeting to-day (Friday) and public examination 13th March, both at Bankruptcy Buildings, Carey Street, London, W.C.2.

S. L. Blythe, G. N. Bryan and **D. Mosley,** formerly trading in copartnership under the style of Kirkstall Radio & Electrical Service, at Kirkstall Lodge, Edwinstowe, Notts, radio and electrical engineers.—Trustee, Mr. D. Armitage, 3, Alfred Street, Leeds, appointed on 30th December in place of Mr. R. B. Smith.

W. E. Sparrow and **F. Sparrow,** electrical contractors, carrying on business under the style of Sparrow & Co., at 8, Longsmith Street, Gloucester.—Supplemental dividend of 2d in the £, payable at the Official Receiver's office, 26, Baldwin Street, Bristol, 1.

NEXT WEEK'S EVENTS

Organizers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

Monday, 16th January

BIRMINGHAM.—Grand Hotel, 6.15 p.m. Birmingham Electric Club. "A Navigational Aid for Ships and Aircraft," by C. Powell.

CARDIFF.—At the South Wales Institute of Engineers, Park Place, 6 p.m. I.E.E. Western Supply Group. "The Supply of Electricity in the London Area," by D. B. Irving.

DERBY.—College of Art, 7 p.m. Institution of Production Engineers, North Midlands Region, Derby Section. "Automation—Some Managerial Problems," by F. Garner.

IPSWICH. — Electric House, 7.15 p.m. Ipswich & District Electrical Association. President's address, by C. T. Melling.

LONDON.—1, Birdcage Walk, 5.30 p.m. Institution of Electrical Engineers. "Advanced Courses for Engineers in Industry," by Dr. Willis Jackson, H. D. Morgan and Prof. G. F. Mucklow. (Joint meeting with the Institutions of Civil and Mechanical Engineers.)

Savoy Place, W.C.2, 6.30 p.m. I.E.E. London Graduates' & Students' Section. Film evening.

MALVERN.—Winter Gardens, 7.30 p.m. I.E.E. South Midland Centre. District meeting. "Loudspeaker Systems—Recent Trends in Design," by Major A. E. Falkus.

NEWCASTLE-UPON-TYNE. — King's College, 6.15 p.m. I.E.E. North-Eastern Radio & Measurements Group. "The Application of the Hall Effect in a Semi-Conductor to the Measurement of Power in an Electro-magnetic Field," and "The Design of Semi-Conductor Wattmeters for Power-Frequency and Audio-Frequency Applications," by Prof. H. E. M. Barlow.

PORTSMOUTH.—C.E.A., High Street, 6.30 p.m. I.E.E. Southern Graduates' & Students' Section. "Communication of Information—Human, Animal and Machine," by Dr. E. C. Cherry.

STAFFORD. — Technical College, 7 p.m. I.E.E. North Staffordshire Sub-Centre. "The Electrification of the Manchester-Sheffield-Wath Lines, Eastern and London Midland Regions, British Railways," by J. A. Broughall and K. J. Cook.

Tuesday, 17th January

EDINBURGH.—Carlton Hotel, North Bridge, 7 p.m. I.E.E. South-East Scotland Sub-Centre. Graham Clark Lecture: "The Engineer's Contribution to the Conservation of Natural Resources," by Sir Harold Hartley. (Joint meeting with the Edinburgh and East of Scotland Association of the Institution of Civil Engineers and the Scottish Branch of the Institution of Mechanical Engineers.)

GLOUCESTER. — Fleece Hotel, Westgate Street, 6.30 p.m. I.E.S. Gloucester & Cheltenham Centre. "Shop and Store Lighting," by R. L. C. Tate.

LEEDS.—1, Whitehall Road, 6.30 p.m. I.E.E. North Midland Utilization Group. "The Installation of Metal-Sheathed Cables Out of Doors on Spaced Supports," by W. Holttum.

LIVERPOOL.—9, The Temple, Dale Street, 6 p.m. I.E.S. Liverpool Centre. "Lighting in Offices," by G. B. Lancaster. (Joint meeting with the E.C.A.)

Adelphi Hotel, 6.30 p.m. Institution of Works Managers, Merseyside Branch. "Electronics as Applied to Industry," by W. A. Turner.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Measurement and Control Section. "A New Meter for the kVA Demand Charge," by P. Baxter.

21, Albemarle Street, W.1, 6.30 p.m. Association of Supervising Electrical Engineers. "Electrical Installations in American Multi-Storey Buildings," by H. C. MacNary.

MANCHESTER.—Free Trade Hall, 7.30 p.m. I.E.E. North-Western Centre. Faraday Lecture: "Coal Mining Electrically," by B. L. Metcalf.

PORTSMOUTH.—"Air Balloon," 598, Commercial Road, Mile End, 7.30 p.m. A.S.E.E. Portsmouth Branch. "Infra-Red Heating," by H. J. Meader.

Wednesday, 18th January

BIRMINGHAM.—James Watt Institute, Great Charles Street, 7 p.m. Institution of Production Engineers, Midlands Region, Birmingham Section. "The Production of Heavy Electrical Rotating Machinery," by L. G. Hawkins.

BOURNEMOUTH.—Grand Hotel, 6.30 p.m. I.E.E. Southern Centre. "Artificial Reverberation," by Dr. P. E. Axon, C. L. S. Gilford and D. E. L. Shorter.

LONDON.—Café Royal, W, 7 for 7.30 p.m. I.E.E. Utilization Section. Dinner-dance.

At the Institution of Civil Engineers, Great George Street, S.W.1, 5.30 p.m. Joint meeting of the Institution of Mechanical Engineers and the British Nuclear Energy Conference. "The Use of Sodium Potassium Alloy as a Heat-Transfer Medium," by Dr. W. B. Hall and T. I. M. Crofts.

Waterloo Bridge House, 5 p.m. Institution of Post Office Electrical Engineers, London Centre. Informal meeting. "Transmission Testing Equipment—Do Current Designs meet our Needs?" by S. H. Chisman and R. W. Lockton.

MIDDLESBROUGH.—Cleveland Scientific & Technical Institute, Corporation Road, 6.30 p.m. I.E.S. Tees-Side Group. "X-Rays in Industry and Medicine," by J. E. Hood and G. Whiteley.

NOTTINGHAM. — E.M.E.B., Showroom Theatre, Smithy Row, 7.30 p.m. A.S.E.E. Nottingham Branch. "The Challenge of Electronics," by G. C. Smith.

PRESTON.—19, Friargate, 7.15 p.m. I.E.S. North Lancashire Group. "Light and its Effect on Plant Growth and Egg Production," by A. E. Canham.

RUGBY.—College of Technology & Arts, 6.30 p.m. I.E.E. Rugby Students' Section. "Electricity in Ships," by J. E. Herrin.

Thursday, 19th January

BIRMINGHAM.—Town Hall. I.E.E. South Midland Centre. Faraday Lecture: "Coal Mining Electrically," by B. L. Metcalf.

Grand Hotel, Colmore Row, 6.45 for 7.15 p.m. Institute of Metal Finishing, Midland Branch. Annual dinner and dance.

CARDIFF.—The Park Hotel, 6.30 for 7 p.m. South Wales Institute of Engineers. Annual dinner.

HULL. — Y.E.B., Ferensway, 7.15 p.m. I.E.E. North Midland Centre, district meeting. Centre Chairman's address, "The Development of Power Station Construction in Leeds and the Surrounding Area," by F. Barrell.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Utilization Section. "Age and the Incidence of Fires in Electrical Installations," by L. Gosland.

Caxton Hall, S.W.1, 2.30 p.m. Diesel Engineers' & Users' Association. "Fundamentals of Free Piston Engines and their Applications," by E. S. L. Beale and P. Watson.

MAIDSTONE.—Royal Star Hotel, 8 p.m. A.S.E.E. Kent Branch. "The National Power Problem," by Dr. Hughes.

MANCHESTER.—N.W.E.B., Town Hall Extension, 6 p.m. I.E.S. Manchester Centre. "Light and its Effect on Plant Growth and Egg Production," by A. E. Canham.

Engineers' Club, Albert Square, 6.45 p.m. Institution of Mechanical Engineers, North Western Branch. Annual general meeting, followed by "The Hydraulic Transport of Solid Material in Pipes," by R. C. Worster and Dr. D. F. Denny.

Engineer's Club, Albert Square, 7.30 p.m. Institution of Engineering Inspection, North-Western Branch. Annual general meeting, followed by film show.

PORTSMOUTH.—College of Technology, 7.30 p.m. Institute of Marine Engineers and Institution of Naval Architects, Southern Joint Branch. "The Cathodic Protection of Ships Against Sea Water Corrosion," by L. T. Carter and J. T. Crennel.

SOUTHAMPTON.—Polygon Hotel, 8 p.m. A.S.E.E. Southampton Branch. "The Industrial Gas Turbine," by J. R. Bolter.

STAINES.—Petters, Ltd., Social Club, 7.30 p.m. Institution of Production Engineers, Southern Region, Reading Section. "Electronics in Industry," by J. A. Sargrove.

WATFORD.—Clarendon Hotel, Station Road, 8.15 p.m. A.S.E.E. Watford Branch. "Commercial Refrigeration," by R. R. Poole.

Friday, 20th January

BLACKBURN.—Golden Lion Hotel, 7.30 p.m. Incorporated Plant Engineers, Blackburn Branch. "Smoke Abatement," by J. Lewis.

LEEDS.—Queens Hotel, 7.30 p.m. Incorporated Plant Engineers, West & East Yorkshire Branch. Annual dinner-dance.

NEWCASTLE-UPON-TYNE. — Old Assembly Rooms. North East Coast Institution of Engineers and Shipbuilders. Annual dinner and dance.

WEYMOUTH.—South Dorset Technical College, 6.30 p.m. I.E.E. Southern Centre. "Heat Pumps," by Miss M. Griffiths.

Saturday, 21st January

OXFORD.—Y.M.C.A., 10, George Street, 6.30 p.m. A.S.E.E. Oxford, Reading & Districts Branch. "Applications of Refrigeration," by D. E. Hall.

TELEVISION IN AUSTRALIA

The annual report of the Australian Broadcasting Control Board states that a provisional plan has been drawn up providing for 120 television stations in Australia. According to the *Financial Times* the Board states that this did not mean there was any present intention of having that many television stations. Channels would be reserved in case they were needed to allow a dual national-commercial system to be established in areas where it could be justified. The report said it was impracticable to make any precise estimate of the likely date for commencement of any television stations the Government had authorized.

The Board proposes to hold a public inquiry into the question of frequency modulation in broadcasting so that its introduction in Australia can be arranged after consideration of all reliable information. The inquiry will be held after the Commonwealth Government repeals the existing prohibition on the use of frequency modulation in broadcasting by commercial stations.

The new frequency channels were needed, the Board said, to allow development of additional national stations, provision of a third national programme, the granting of licences for additional commercial stations and the establishment of stations in areas with rapidly increasing populations.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 15th February from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1949

29879. N.S.F., Ltd., and Smith, K. G.—Light current electric switches. 22nd November, 1950. (744811.)

1950

23558. Standard Telephones & Cables, Ltd.—Processing of copper wire or rod. 21st September, 1951. (744971.)

1951

10317. Dubilier, W.—Manufacture of electrical capacitors. 30th April, 1952. (744893.)

18084. Kunze, A.—Galvanic batteries. 31st July, 1951. (744894.)

19833. Mavor & Coulson, Ltd., and Towler, J. M.—Means for protecting power supply conduits, or cables, connected to vehicles. 8th May, 1953. (744973.)

21414. Henley's Telegraph Works Co., Ltd., W. T., Brice, P. J., and MacDonald, H. A.—Apparatus for the continuous measurement of objects of great length. 11th September, 1952. (744743.)

1952

7693. General Electric Co., Ltd., Breadner, R. L., and Simms, C. H.—Electrical devices having envelopes provided with terminal pins. 3rd March, 1953. (744751.)

9888. National Research Development Corporation.—Electron discharge tube grid production. 16th July, 1953. (744815.)

9927. Fielden Electronics, Ltd.—Capacity measuring devices. 24th April, 1953. (744754.)

15467. British Thomson-Houston Co., Ltd.—Production of luminescent screens. 11th June, 1953. (744898.)

20056. Siemens Electric Lamps & Supplies, Ltd.—Fluorescent materials. 7th August, 1953. (744979.)

24636. General Electric Co., Ltd., Breadner, R. L., and Simms, C. H.—Manufacture of electrical devices having a sealed evacuated envelope. 23rd September, 1953. (744758.)

26543. Dowty Equipment, Ltd.—Synchronizing means in electric remote control systems of the so-called stepless type. 21st January, 1954. (744900.)

26765. General Electric Co., Ltd., and Cates, J.—Electric circuit arrangements for starting and operating from an a.c. supply a pair of heatable cathode low pressure electric discharge lamps. 25th January, 1954. (744819.) 26766. Electric circuit arrangements for starting and operating from an a.c. supply a pair of low pressure electric discharge lamps. 6th January, 1954. (744820.)

29322. Cinema-Television, Ltd.—Cathode-ray tube apparatus. 19th November, 1953. (744760.)

30091. British Thomson-Houston Co., Ltd.—Electromagnetic control devices. 5th November, 1953. (744668.)

1953

658. Marconi's Wireless Telegraph Co., Ltd.—Reactance valve circuit arrangements. 27th November, 1953. (744901.)

1006. General Electric Co., Ltd., and Friedlander, E. S.—Polyphase magnetic amplifier arrangements. 13th January, 1954. (744990.)

3587. Besson & Robinson, Ltd., and Besson, A. P.—Electric switching devices for use with coaxial cables. 8th February, 1954. (744832.)

4106. English Electric Co., Ltd.—Annular joints. 12th February, 1954. (744994.)

4419. Besson & Robinson, Ltd., and Besson, A. P.—Electromagnetic relays. 17th February, 1954. (744905.)

5171. Ionlite, Ltd.—Electric lighting fittings. 24th February, 1954. (744835.)

5624. Radio Corporation of America.—Cathode shield for electron power tube. 27th February, 1953. (744766.) 6178. Electron power tube. 5th March, 1953. (744769.)

6610. Elektromekano Aktieselskab.—Speed indicator for an electrical generator. 8th March, 1954. (744678.)

6889. British Broadcasting Corporation.—Testing of electric communication channels. 12th March, 1954. (744910.)

6918. Furness, H. W.—Electrically operated burglar or theft alarms. 11th March, 1954. (744911.)

7341. British Thomson-Houston Co., Ltd.—H.f. power measuring apparatus. 17th March, 1954. (744771.)

7608. Pye, Ltd.—Deflector coil arrangements for cathode-ray tubes. 1st March, 1954. (744997.)

7803. Sylvania Electric Products, Inc.—Method of and apparatus for producing planar grids for electron-discharge devices. 20th March, 1953. (744838.)

7993. Walsall Conduits, Ltd.—Electrical socket connectors. 15th March, 1954. (744915.)

8785. General Electric Co., Ltd., and Goodings, D. B.—Electric protective schemes. 2nd March, 1954. (744775.)

9058. Philips Electrical Industries, Ltd.—Cathode-ray tubes. 1st April, 1953. (744776.)

10367. Electric & Musical Industries, Ltd.—Electrical voltage indicating systems. 15th April, 1954. (744999.)

11083. General Electric Co.—Snap-action devices particularly for electric switches operating in response to temperature or pressure changes. 22nd April, 1953. (744683.)

13088. General Electric Co.—Hall effect apparatus. 11th May, 1953. (744919.)

13587. Carr Fastener Co., Ltd.—Means for mounting holders for thermionic valves, electrical plugs or like electrical devices having projecting terminal prongs. 21st April, 1954. (745002.)

13680. Philips Electrical Industries, Ltd.—Method of introducing an ignition device in the bulb of a flashlight lamp. 15th May, 1953. (744848.)

16790. M-O. Valve Co., Ltd., and Kettlewell, E.—Magnetrons. 2nd June, 1954. (744788.)

16999. Sylvania Electric Products, Inc.—Methods of making barriers in semi-conductors. 19th June, 1953. (744929.)

19044. Electric & Musical Industries, Ltd.—Cathode-ray tube apparatus. 14th June, 1954. (745009.)

19231. Standard Telephones & Cables, Ltd.—Moisture-tight seals for electric conductors passing through bulkheads. 2nd July, 1954. (744934.)

19687. Jones & Co. (Engineers), Ltd., W.—Carrier current motor generators for voice frequency telegraph transmission. 9th July, 1954. (744936.)

19934. Metropolitan-Vickers Electrical Co., Ltd.—Mounting of X-ray apparatus. 19th July, 1954. (745010.)

20472. Philips Electrical Industries, Ltd.—Trimmer capacitors. 23rd July, 1953. (744937.)

20944. Gilkes & Gordon, Ltd., G., Stagg, F. G., and Stride, P. J. E.—Speed control of electrical a.c. generators. 28th July, 1954. (744694.)

21207. Cathodic Corrosion Control, Ltd.—Method of and apparatus for determining the resistivity of an electrolyte. 30th July, 1954. (744697.)

21627. Rheostatic Co., Ltd.—Control systems for combustion furnaces using fluid or pulverized fuel. 22nd July, 1954. (744859.)

22179. Automatic Telephone & Electric Co., Ltd.—Signalling devices. 12th May, 1954. (744700.)

23426. Mullard Radio Valve Co., Ltd.—Radar circuits. 25th August, 1953. (745014.)

23427. Mullard Radio Valve Co., Ltd.—Circuit arrangements. 25th August, 1953. (745015.)

25336. British Thomson-Houston Co., Ltd.—Glass compositions. 10th August, 1954. (744947.)

25412. Bosch, Ges., R.—Electrically driven portable machine tools. 15th September, 1953. (744948.)

25706. Svenska Aktiebolaget Gasaccumulator.—Electrical connector and method of manufacturing same. 17th September, 1953. (744795.)

28488. Philips Electrical Industries, Ltd.—Cathode-ray tubes. 15th October, 1953. (744955.)

28507. Telephone Manufacturing Co., Ltd.—House telephone systems. 8th October, 1954. (744872.)

29298. Westinghouse Brake & Signal Co., Ltd., Duckitt, H., and Tillotson, P.—D.c. track circuits for railway signalling systems. 29th July, 1954. (744874.)

29522. Philips Electrical Industries, Ltd.—Magnetrons. 26th October, 1953. (744713.)

29727. Telefonaktiebolaget L. M. Ericsson.—Thermally responsive electric devices for switching or switching and indicating. 27th October, 1953. (744714.)

30093. Standard Telephones & Cables, Ltd.—Coupling circuit for high frequency transmission systems. 30th October, 1953. (744715.)

30152. Union Carbide & Carbon Corporation.—Refractory metal electrodes for use in gas-shielded arc welding and cutting. 2nd November, 1953. (745023.)

30259. Epsylon Research & Development Co., Ltd., and Namenyi-Katz, L.—Electromagnetic recording heads. 28th April, 1954. (744960.)

31417. Siemens & Halske Akt.-Ges.—Electromagnetic relays. 12th November, 1953. (744719.)

31862. Philips Electrical Industries, Ltd.—Automatic telephone exchange systems. 17th November, 1953. (745026.)

33191. Philips Electrical Industries, Ltd.—Ion sources. 30th November, 1953. (744882.)

34319. Accumulatoren-Fabrik Akt.-Ges.—Electric accumulators employing alkaline or neutral electrolytes. 9th December, 1953. (744726.)

35440. Bescol (Electric), Ltd.—Electric convector heaters. 20th December, 1954. (745031.)

35636. Stiebel, T. H.—Electrical immersion heater. 22nd December, 1953. (744885.)

36359. British Thomson-Houston Co., Ltd.—Scanning aerials. 29th December, 1954. (745038.)

1954

28348/9. Philips Electrical Industries, Ltd.—Cathode-ray tubes. 1st April, 1953. (744807/8.)

1955

4138. Dubilier, W.—Manufacture of electrical capacitors. 30th April, 1952. (744969.)

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—31st January. Director, Posts and Telegraphs, G.P.O., Melbourne. Plugs, jacks and cords. (E.S.B. 28342/55. Ten/17379.)*

16th February. Director, Posts and Telegraphs, G.P.O., Melbourne. Telephone cords, dials, plugs, switches, etc. (E.S.B. 27559/55. Ten/17390.)*

1st March. Western Australian Government Railways Commission. Electrical equipment for the new Westland train. (E.S.B. 28521/55. Ten/17369.)*

6th March. Sydney County Council. 11,000 V, 250 MVA metalclad switching equipment for Marrickville substation. (E.S.B. 28363/55. Ten/17374.)*

13th March. Snowy Mountain Hydro-Electric Authority. Seven 330 kV, 340 A cables with terminations for T1 power station. (E.S.B. 28647/55. Ten/17370.)*

Belfast.—2nd February. City Electricity Department. Engineers' tools and lifting appliances for Municipal Electric Power Station West. (See this issue.)

Bridlington.—4th February. Borough Council. Four sets of electrically powered centrifugal pumping plant and equipment for Burton Agnes pumping station. Water engineer, Marton Road.

Brazil.—21st February. Servico Municipal de Transportes Coletivos, Santos. Fifty trolleybuses and equipment. (E.S.B. 28368/55. Ten/17392.)*

Canada.—18th January. Manitoba Hydro-Electric Board. One 6,000/8,000 kVA and four 3,750/5,000 kVA transformers for Brandon generating station. (E.S.B. 28458/55. Ten/17347.)*

Denbighshire.—County Council. Electrical installation in proposed secondary school, Gwersyllt, Wrexham. (See this issue.)

Dollar.—Town Council. Street lighting equipment. (See this issue.)

Dublin.—31st January. Port and Docks Board. Electrical installation for the new graving dock at Dublin Port. (See this issue.)

Dundee.—2nd March. North of Scotland Hydro-Electric Board. Cooling water supply and discharge pipes for an extension to Carolina Port generating station. (See this issue.)

Formosa.—1st February. Central Trust of China, Taipei. Three 50 kVA transformers. (E.S.B. 28467/55. Ten/17328.)*

Gillingham (Kent). — 23rd January. Borough Council. Supply of switches and accessories (Schedule 13); conduits and accessories (14); wire, cables and accessories (15); and lamps (16), for the year ending 31st March, 1957. Borough surveyor, Municipal Buildings.

Greece.—29th February. Greek Public Power Corporation. Plant for a 70,000 kW lignite burning, thermal electric generating station. (E.S.B. 28767/55. Ten/17415.)*

Hertfordshire.—County Council invites applications for inclusion on their list of contractors for building and maintenance works, heating and electrical work, fencing works, etc. (See this issue.)

Huddersfield. — 31st January. Borough Council. Supply of lamps and cables for the year ending 31st March, 1957. Borough engineer, High Street Buildings.

Huntingdonshire.—31st January. County Council. Street lighting equipment. (See this issue.)

India.—20th January. Stores Purchase Committee, Government of Mysore. Underground cable. (E.S.B. 28683/55. Ten/17358.)*

13th February. India Supply Mission, Washington. Radar sets and radar altimeter. (E.S.B. 28003/55. Ten/17316.)*

20th February. Department of Electricity, Government of Madras. Power transformers. (E.S.B. 28665/55. Ten/17357.)*

Iraq.—1st February. Central Foreign Purchasing Board. Forty 20 to 30 W and twenty-five 50-100 W radio sets. (E.S.B. 85/56. Ten/17402.)*

Korea.—25th January. Office of Supply, Seoul. Telephone and telegraphic apparatus and electric motors. (E.S.B. 28732/55. Ten/17405.)*

New Zealand.—22nd February. Post and Telegraph Department, Wellington. Switchboard cable. (E.S.B. 289/56. Ten/17414.)*

28th February. 1,600 junction blocks. (E.S.B. 288/56. Ten/17423.)*

15th May. State Hydro-Electric Department, Washington. Three 17,000 kW, 18,888 kVA generators. (E.S.B. 28576/55. Ten/17363.)*

Northampton.—17th February. Northamptonshire Water Board. Electric wiring installation at Pitsford Reservoir Works. (See this issue.)

Nottinghamshire.—8th February. County Council. Street lighting equipment. (See this issue.)

Persia.—19th February. Ministry of Posts and Telegraphs, Teheran. Automatic telephone equipment. (E.S.B. 27450/55. Ten/17332.)*

Richmond (Yorks).—20th January. R.D.C. Duplicate set of vertical spindle electrically driven centrifugal pumps for Catterick Village sewerage. J. T. Powell, surveyor, 56, Market Place.

Salvador.—17th February. Instituto de Vivienda Urbana, San Salvador. Fifty electric cookers, table type. (E.S.B. 28370/55. Ten/17383.)*

Sedgley.—31st January. U.D.C. Street lighting equipment. (See this issue.)

South Africa.—17th January. City of Johannesburg, City Treasurer's Department. Distribution transformers. (E.S.B. 27887/55. Ten/17318.)*

27th January. Stores Department, South African Railways. Lamps. (E.S.B. 28552/55. Ten/17331.)* Cable joint and end boxes. (E.S.B. 28553/55. Ten/17330.)* 1st February. Private automatic exchange. (E.S.B. 28659/55. Ten/17381.)*

3rd February. City of Durban Electricity Department. Six 33 kV sealing ends with current transformers. (E.S.B. 28240/55. Ten/17307.)*

15th March. Cape of Good Hope Provincial Administration. Hydro-electric generating plant, switchgear and accessories for Wemmershoek treatment plant. (E.S.B. 28639/55. Ten/17373.)*

Southern Rhodesia.—1st February. Municipality of Umtali. L.v. cable. (E.S.B. 28278/55. Ten/17356.)*

Swanley.—25th January. Parish Council. Street lighting equipment. (See this issue.)

United States.—Public Utility District, Grant County. Power plant and appurtenances for the Priest Rapids dam. (E.S.B. 25131/55. Ten/16849A.)*

19th January. Department of Interior, Bureau of Reclamation. 10,000/12,500 kVA auto-transformer for Lingle switchyard. (E.S.B. 28037/55. Ten/17387.)* 26th January. Main control, supervisory control and distribution boards for Heyburn substation and supervisory control equipment for Minidoka power plant. (E.S.B. 28492/55. Ten/17399.)* 31st January. Control boards, supervisory control and telemetering equipment for Granite Falls and Watertown substations. (E.S.B. 28485/55. Ten/17380.)*

Uruguay.—30th January. Administration de Ferrocarriles del Estado Department de Proveeduria. Insulated cable. (E.S.B. 27814/55. Ten/17325.)* 10th February. Vulcanized fibre insulators for electric signals. (E.S.B. 175/56. Ten/17424.)*

31st January. Administracion General de las Usinas Electricas y los Telefonos del Estado. Carrier-current telephonic equipment and amplifiers. (E.S.B. 27812/55. Ten/17319.)* 1st February. Double copper conductors. (E.S.B. 27813/55. Ten/17345.)*

10th February. Administracion General de las Usinas Electricas y los Telefonos del Estado. Electrical porcelain material. (E.S.B. 171/56. Ten/17425.)*

Westminster.—23rd January. City Council. Supply of electric lamps and starter batteries for one year to 31st March, 1957. Town clerk, Westminster City Hall, London, W.C.2.

Witney.—4th February. U.D.C. Street lighting equipment. (See this issue.)

* **Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).**

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Ayr.—Houses (48), at St. Quivox Road; burgh surveyor.

Banstead.—Installation of lifts at Banstead Hospital; Geo. Lowe, architect, 4, High Street, Croydon.

Barrow-in-Furness. — Works, Sowerby Woods; British Cellophane, Ltd., Bridgwater, Somerset.

Proposed extensions to County Grammar School for Boys; borough surveyor.

Belfast.—Two technical intermediate schools for E.C.; city surveyor, City Hall.

Bootle.—Church of Holy Ghost at Poulsom Drive; Weightman & Bullen, architects, 76, Rodney Street, Liverpool.

Bournemouth.—Large expansion of business premises; J. J. Allen, Ltd., house furnishers, etc., The Quadrant.

Factory at West Howe (£250,000), for Flight Refuelling, Ltd.; Alexander W. Stewart, architect, Hinton Chambers, Hinton Road, Bournemouth.

Bridlington.—Fish factory, industrial estate; A. Baron, wholesale and retail fish merchant, 34, Lansdowne Road.

Carlisle.—Science laboratories block at Carlisle and County High School for Girls (£26,640) and additions to Barn Close Home for Old People (£35,000); city engineer, 18, Fisher Street.

Cheltenham.—Dwellings (752), Benhall Farm estate; Geo. Wimpey & Co., Ltd., 23, Hammersmith Grove, London, W.6.

Cork.—School for Order of the Presentation; Frank Murphy, architect, 51, South Mall.

Corsham (Wilts).—Re-development of town centre to provide for 68 houses and flats, shops, cinema, etc., for Calne and Chippenham R.D.C.; E. W. Stevens, surveyor, Bewley House, Marshfield Road, Chippenham.

Coventry.—Second instalment of scheme for new council offices (£171,650); city architect, Bull Yard, off Warwick Row.

Dartford.—Extensions to physical training college; Slater, Uren & Pike, architects, 29, Gower Street, London, W.C.1.

Durham.—Additions to Dryburn Hospital for Newcastle Hospital Board, Benfield Road, Newcastle-on-Tyne; chief architect.

Eccles.—County secondary school; W. Fearnley & Son, Ltd., Constance Works, Eccles New Road, Salford, 5.

Essex.—Hostel for the aged at Fencepiece Road, Chigwell (£50,000) and second instalment of North East Essex Technical College, Colchester; H. Conolly, county architect, County Hall, Chelmsford.

Falkirk.—Houses (97), at Camelon (£122,000); burgh surveyor.

Farnborough.—Houses (415), on Oak Farm estate, Cove; B. H. Cutler, Ltd., builders, 52, High Street, Pinner.

Farnworth.—Extensions to factory for De Havilland Propellers, Ltd.; Bovis, Ltd., 1, Stanhope Gate, London, W.1.

Flintshire.—Secondary modern school at Hope (£101,000), extensions to St. Asaph Grammar School (£90,000) and junior and infants' school at Connah's Quay (£47,000); county architect, County Buildings, Mold.

Forfar.—Extensions to business premises, Castle Street (£25,000), for F. W. Woolworth & Co., Ltd.; staff architect, 1, New Bond Street, London, W.1.

Gateshead.—Houses (208), on the Lobley Hill estate; borough engineer, Municipal Buildings.

Development department, comprising offices, workshops and laboratories, for Clarke, Chapman and Co., Ltd.; Brims and Co., Ltd., builders, Pandon Buildings, City Road, Newcastle-on-Tyne.

Grimsby.—Showrooms and offices, George Street; R. W. Brown, architect, 31, Osborne Street.

Halesowen.—Proposed erection of five blocks of flats at Bath Meadow, Belle Vue site; borough surveyor.

Hemel Hempstead.—Out-patients' department with two wards over at the West Herts Hospital, for North West Metropolitan Regional Hospital Board; regional architect, Sheffield House, Sheffield Street, London, W.C.2.

Church, Bennetts End; Dawe, Carter & Partners, architects, 33, Clarendon Road, Watford.

High Wycombe.—Departmental store; Murrays (High Wycombe), Ltd., 27, White Hart Street.

Jarrow.—Flats (72) (£106,106); H. W. T. Perkins, borough engineer.

Kirkby-in-Ashfield.—Aged persons' hostel on the Kingsway estate (£38,000); county architect, County Hall, Trent Bridge, Nottingham.

Kirkcaldy.—Crematorium (£80,000), Dunniker Park; Sanger & Rothwell, architects, Yorkshire Street, Oldham.

Knapton (Yorks).—Grain maltings for Associated British Maltsters, Ltd.; Gelder & Kitchen, architects, 120, Alfred Gelder Street, Hull.

Leyton.—Health Department offices; Tooley & Foster, architects, Midland Bank Chambers, Buckhurst Hill.

Lincoln.—Extensions to premises, Outer Circle Road; Penney & Porter, Ltd., engineers, Waterside South.

Llanfyllin.—Council chamber and offices; R. A. Jones, consulting architect, Bwythyn-Hedd, Llanfyllin.

London.—Church hall and flats, Arlington Road, Camden Town; Poolman, Ltd., builders, Quadrex House, Park Lane, W.1.

Warehouse and offices, Worship Street; S. T. L. Motor Cycle Accessories, Ltd., 179, Caledonian Road, N.1.

Modernization of offices, Northumberland Avenue; L. W. Hammerson & Partners, 132, Park Lane, W.1.

Divisional police headquarters at Gresham Road, Brixton, S.W.9; Metropolitan Police Commissioners, New Scotland Yard, S.W.1.

Offices, New Turnstile Street, Holborn; Charles R. Price, builder, Kingsbury Road, N.W.9.

Long Ashton.—Houses (201), in five parishes; R.D.C. surveyor, Council Offices, Cambridge Batch, Flax Bourton, nr. Bristol.

Longframlington.—County library; county architect, County Hall, Newcastle-on-Tyne.

Luton.—Cleaner factory for Electrolux, Ltd., Oakley Road; A. W. West, surveyor, Clarence House, Arthur Street, London, E.C.4.

Manchester.—Factory and offices at Shentonfield Road and Carrsfield Road, Northenden, for Hilson Wire Products, Ltd.; Philip E. B. Bamforth, architect, 28, Ryebank Road, Firswood.

Middlesbrough.—Houses (84); borough engineer.

Crematorium for the T.C.; J. A. Kenyon, borough engineer.

Newcastle-on-Tyne.—Works extensions, Scotswood; Aveling Barford, Ltd., Victa Works, Grantham.

Swimming baths, Ponteland Road (£179,161); G. Kenyon, city architect.

Proposed Firfield Secondary Boys' School for the E.C. (£125,000); William Leech, Ltd., builders, St. James' Street, Newcastle-on-Tyne.

Newquay.—Concert hall, for U.D.C.; Vyvyan Salisbury, architect, 88, Molesworth Street, Wadebridge.

Northampton.—Out-patients' department for General Hospital; W. F. Howard, architect, 110, Old Brompton Road, London, S.W.7.

Northolt.—Milk distribution depot; Express Dairy Co., Ltd., Tavistock Place, London, W.C.1.

North Riding.—Old people's home, Thornaby, for the C.C. (£40,000); Hudson Brothers, builders, Fidler Street, Middlesbrough.

Nottingham.—Two-storey shopping arcade, etc., South Parade; Norwich Union Insurance Societies, Head Office, Surrey Street, Norwich.

Oxford.—Large block of offices, St. Michael's Street; Alliance Assurance Co., Ltd., Bartholomew Lane, London, E.C.2.

Plymouth.—Proposed cinema, Union Street; 20th Century Fox Film, Ltd., 31, Soho Square, London, W.1.

Redditch.—Houses (200), Studley Road estate; C. Bryant & Son, Ltd., builders, 65, Whitmore Road, Birmingham.

Sedgefield.—Houses (80), for the R.D.C.; G. M. Pearson and Son, builders, Front Street, Hetton, Co. Durham.

Staffordshire.—Erection of three fire stations, and scheme for modernization of 13 fire stations (£292,000); A. C. H. Stillman, county architect, Martin Street, Stafford.

Stanley (Co. Durham).—Alterations and additions to Empire Club (£20,000); J. G. Cowe and Son, architects, Claremont Place, Newcastle-on-Tyne.

Glove factory for Pinkham and Sons; Marshall and Tweedy, architects, 36, Blackett Street, Newcastle-on-Tyne.

Stockton-on-Tees. — Houses, Bishopton Road; Shannon (Contractors), Ltd., 48, Marsh Road, Middlesbrough.

Sutton Coldfield.—Houses (143), Wylde Green Road; Allton Estates, Ltd., 658, Chester Road.

West Bromwich.—Factory and offices, Hamstead Road; Henry Showell & Co., Ltd., 28, Nursery Road, Birmingham.

Whyteleafe.—Works extensions; Strong Electric Corporation (Great Britain), Ltd., New Bourne Works, Whyteleafe Hill.

Electrical Imports of Egypt

Egyptian imports of electrical machinery and apparatus in 1954 showed a slight decline, the total value being £E7,393,000 compared with £E7,741,000 in the preceding year. There were noteworthy decreases in the telegraph and telephone group, refrigerators and washing machines. On the other hand business in power plant was about 25 per cent up.

Not much detail about countries of origin has been available since 1951 but such information as is forthcoming for 1954 shows how Germany has progressed. In the highly competitive trade in cable and wire her share then was £E528,000 against £E324,000 in 1953; that of the Netherlands fell to £E233,000 (£E519,000), while France stood at £E221,000 (£E99,000), Belgium at £E75,000 (£E126,000) and Italy £E71,000 (£E106,000). It will be seen from the accompanying table that Germany also led in the imports of generators, motors and transformers. (£E1 = £1·03 sterling.)

Class of Equipment	1954 £E (000)	Inc. or dec. on 1953 £E (000)
Generators, motors and transformers	697	+ 139
From U.K.	118	— 27
,, *W. Germany*	227	+ 103
,, *Belgium*	24	— 7
,, *France*	157	+ 100
,, *Switzerland*	29	— 8
,, *U.S.A.*	6	— 79
Elec. locos.	8	— 1
Batteries, pocket	25	— 7
Batteries, not pocket, and parts	323	+ 41
Magnetos, etc.	54	— 24
Fans	93	+ 48
Accumulators and parts	261	— 16
From U.K.	54	— 7
,, *U.S.A.*	12	+ 5
Lamps for lighting	153	+ 18
From U.K.	16	+ 2
,, *Netherlands*	59	— 6
,, *Hungary*	14	+ 1
,, *U.S.A.*	26	+ 6
Lamps not for radio or lighting	16	+ 2
Valves for radio transmitters	2	+ 1
Valves for radio receivers	135	+ 7
Telegraph and telephone apparatus and parts	279	— 297
From U.K.	130	— 34
Components for radio receiving sets	102	+ 16
Ditto, transmitting sets	8	+ 5
Radio receiving sets less valves	761	+ 52
From U.K.	74	+ 41
,, *W. Germany*	217	— 128
,, *Netherlands*	361	+ 164
,, *U.S.A.*	7	— 2
Radio gramophones less valves	22	— 3
Radio transmitting sets	6	+ 1
Other radio appliances, parts and components	142	— 85
Signalling apparatus	37	+ 18
Medical apparatus	77	+ 27
Irons and parts	22	+ 1
Refrigerators, domestic	101	— 99
From W. Germany	54	— 2
,, *U.K.*	23	+ 22
Water heaters	7	— 6
Cookers	2	+ 1
Washing apparatus	44	— 27
Other domestic appliances	70	+ 12
Cable, insulated, submarine and underground	1,295	— 116
Wire and cable, electric, unspecified and parts	408	+ 42
Carbons	50	— 9
Insulating tubes	21	— 4
Articles for electrical uses, porcelain, glass, asbestos, etc.	26	— 19
Apparatus and parts, n.e.s., 250 grammes and over	1,759	— 64
Ditto, less than 250 grammes	382	+ 106